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VACCINATION

AS A

PREVENTIVE OF SMALL-POX.

BY

W. C. CHAPMAN, M. D.

VICE-PRESIDENT TOLEDO MEDICAL ASSOCIATION,
MEMBER OF OHIO STATE MEDICAL
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VACCINATION

—AS A—

PREVENTIVE OF SMALL-POX,

—BY—

W. C. CHAPMAN, M. D.,

TOLEDO, OHIO.

Although there has been much written upon the subject of small-pox, and the methods which have been instituted for the prevention of its development and spread, still at the present day epidemics of the disease do occur at various times in different localities to such an extent that much apprehension is occasioned in any community in which it appears, and the question arises, Why, if vaccination is efficacious as a means of prevention, the disease has not been banished forever from the face of the earth. It is well also to inquire to what extent the medical profession is responsible for its appearance. At the present time Cincinnati and many other cities are being visited by an epidemic of small-pox. In the first named city a mortality is reported from this disease which is astonishingly great. If, as has been intimated by the public press, a portion of the medical profession have advised a disregard to the operation of vaccination as a prophylactic measure, it is certainly to be deplored. The following, taken from a daily paper, certainly shows a prejudice as existing in the minds of

some of the profession which is unaccountable: "The existence of small-pox as an epidemic in this city is directly traceable to an unreasonable and fatal prejudice on the part of a portion of our citizens against vaccination. Five years ago half a dozen German physicians in Cincinnati began to oppose vaccination. They were physicians of large practice among their own people, and their influence resulted in building up an antipathy to this means of preventing the pestilence that would be unaccountable, were we not familiar with the cause. The legitimate results have followed, small-pox is in our own midst, and 75 per cent. of its victims are taken from the very class referred to. The statistics of the Health Office show further that a very large proportion of the deaths is of children *under five years of age.* These facts certainly seem to locate a good share of the responsibility."*

It is not alone the mortality tables that demonstrate the losses sustained by a community by reason of the prevalence of a small-pox epidemic. A very able paper presented by Dr. Benjamin Lee, of Philadelphia, to the Public Health Association at its meeting in Baltimore, shows "an approximate determination of the loss sustained by the city of Philadelphia, in dollars and cents in consequence of the presence of small-pox in the winter of 1871-72, and placing side by side with this the degree in which this loss might have been prevented by judicious sanitary legislation rigidly enforced." The total loss sustained during the epidemic of those years is placed at the enormous figure of nearly twenty three million dollars, and Dr. Lee believes that 90 per cent. of the cases and 97½ per cent. of the deaths could have been avoided, and that less than three quarters of a million dollars would have represented the total loss by sickness, death, and disability. Averaging the value of a human life, he finds that the actual loss sustained by reason of sickness, death, and disability was nearly sixteen and a half million dollars.

When such statements as the foregoing are presented to the public, every one naturally asks the question, why proper attention is not given to the subject by those who are supposed to be responsible for the health of the community. To some extent the medical profession, no doubt, is blame-worthy, in not giving more attention to the enforcement of those operations which are known as being competent to stamp out the disease. The general public, however, are to be censured in resisting the attempt which has been made to institute prophylactic procedures. This dislike arises, to a great degree,

*Cincinnati Gazette, December 10, 1875.

from an ignorance upon the part of the people as to the nature of the operation of vaccination, and a dread that in the introduction of the vaccine virus, other poisons may enter the system, to remain there through life. A thorough presentation of the whole subject of vaccination can not but result in great good to all concerned; and a proper attention to the performance of the operation itself by the profession will tend to give that confidence which is so much needed in any community. It is a fact that some mothers have such a dread of vaccination that fear engendered by an epidemic of small-pox is scarcely able to force a consent to its performance.

It is with the intention of presenting, as clearly as possible, the various questions arising in a consideration of the operation of vaccination, that this article has been prepared; hoping that, while the profession may find some points which may be of value, others who are interested in the public welfare may also become somewhat acquainted with the nature of the operation, and that by a candid presentation of all the points involved in a discussion of the question, much of the existing prejudice may be overcome.

In order that a thorough understanding of the benefits which have been derived from the introduction of prophylactic measures may be arrived at, it is well to briefly review the history of the origin and spread of small-pox in former centuries with its attending frightful mortality.

There is scarcely any portion of the habitable globe that has not been visited by this disease, and it is therefore difficult to ascertain the locality in which it originated. Many opinions have been given by various writers as to the time when, or the place where, it first appeared. There is a difficulty in the way of clearly tracing the time of its origin, on account of the confusion existing in the descriptions given by early writers of all the then prevailing diseases. Nearly every disease that was at all fatal was called the *plague*, and it was a long time before measles and small-pox were considered as separate diseases.

In the siege of Alexandria much valuable information, which had been preserved in the writings of Ahron, were destroyed. He was considered as the first who wrote upon the subject of small-pox. Some have endeavored to prove that the disease first made its appearance among the Greeks and Romans, others that its origin dates back many centuries, and was known in China and India. The writings of many go to prove that about the time of the birth of Mahomet, the small-pox suddenly appeared in Arabia, and Procipius describes a disease

which made its appearance at Pelusiam in Egypt, about the year 544 A. D., and from thence carried into Turkey. In all its characteristics it closely resembled the small-pox of the present day. Authorities do not agree, however, on this point; many suppose that he described the *bubo-plague* which was known to infect Egypt.

In the year 569 the Abyssinian army, which had besieged Mecca, was compelled to retreat on account of the terrible ravages made by this disease. The belief that small-pox was first known about this time is further confirmed by the writings of Bruce, an African traveler, who found, in a manuscript portraying the events of this war, an extended account of a disease with similar characteristics to small-pox.

The defeat of the besieging army surrounding Mecca was looked upon by the Arabians as a miraculous interposition in their favor. Gibbon thus refers to the invasion of Arabia by the army of Africans: "The Kingdom of Yemen was subject to the Christian Princes of Abyssinia, their vassal Abrahah was provoked by an insult to avenge the honor of the Cross; and the holy city was invested by a train of elephants and an army of Africans. The want of provisions or the valor of the Koreish compelled the Abyssinians to a disgraceful retreat. Their discomfiture has been adorned with a miraculous flight of birds, who showered down stones on the heads of the infidels; and their deliverence was long commemorated by the era of the elephant."*

Moore considers that the fact of the existence of small-pox in China and India in remote ages as clearly proven. "This belief is founded upon a work written in China in the year 1120 B. C., "Treatise on Small-Pox" (Teontahinfa), which contains a collection of the oldest medical knowledge of the Chinese concerning the disease. It is also reported from India, that long before the birth of Christ, a particular Goddess had been worshiped as protectress against the disease, and also that from a remote period her priests practiced the inoculation of small-pox for protection against the disease."†

If the small-pox had existed for a long period of time in either India or China, it would have been impossible for the surrounding nations to have been free from its influence. It is well known that there existed an extensive mercantile intercourse between India, Egypt, and adjoining countries for centuries. If the disease had existed in the one, it would certainly have been transported to the other. Dr. Woodville

*Decline and Fall of the Roman Empire.

†Curschmann, Ziemssens Cyclopædia, Vol. II., p. 321.

concludes that there is much doubt in regard to the antiquity of small-pox in India. He considers that so contagious a disease as small-pox could not have existed in the East without having been transferred to other nations. He thinks the disease was introduced into India from Arabia.

The Arabian physicians were first to describe the disease, and to give therapeutical directions as to its management. Among the number may be mentioned, Rhazes, Avicenna, and Hali Abbas, these three being the more prominent.

If it is certain that the disease described by Procipius, which made its appearance in Egypt in the year 544, was true small-pox, it is possible or even probable that the disease originated in Africa, and the fact of the epidemic springing up in the African army of Abrahah as it besieged Mecca, twenty five years thereafter, would show that perhaps the *true bubo-plague* and *small-pox* had a common point of origin in Africa. It is certain that after the disease had appeared in Arabia it rapidly spread into India and other adjacent countries, so that, toward the end of the sixth and beginning of the seventh centuries, Palestine, India, Egypt, and Persia were all suffering from the dreadful scourge.

Europe was not long free from its invasion. The fact that intercourse was yearly increasing between nations, the way was open for the introduction of the infection. The date is not fully established at which it appeared in this country. Gregory of Tours speaks of a disease which appeared in southern Europe in the year 581. From the description given by him, the character of true small-pox is made apparent. There are those, however, who consider that with the invasion of Europe by the Saracens the disease was introduced. It is, however, probable that it had been known in this portion of the globe many years before the Saracen invasion.

In the Harleian manuscripts, published some time before the year 900, the word variola is used, and Moore, in his history of small-pox, states that the word occurs in the Bertinian Chronicles published in the year 961. The dread in which the disease was held by the people is shown by the following prayer found in the first named manuscript: "In the name of the Father, of the Son, and of the Holy Ghost, Amen. May our Saviour keep us. Lord of Heaven, hear the prayers of thy men servants and of thy maid servants, O, Lord Jesus Christ? I beseech thousands of angels, that they may save and defend me from the fire and power of the small-pox."

Gradually the disease spread through all Europe, England, France, and Germany. All dreaded its ravages, their seeming

to be no power to stay it in its march of destruction. After the discovery of America the disease followed emigration, appearing first in Mexico in the year 1527. In the city of Mexico alone, it is stated that three and a half millions of people were destroyed in a very short period of time. During the eighteenth century, one-tenth of the population of the globe died, while one-tenth more were disfigured by its ravages. In Europe 400,000 persons died annually from this cause alone. Dr. De Renzy, Sanitary Commissioner for the Punjab says (at the present time in this province, with a population of 18,000,-000, the deaths from small-pox are never less than 20,000 a year; in 1869 they numbered 53,195): "In England, in the seventeenth and eighteenth centuries, seven to nine per cent. of all deaths were attributable to small-pox. In Berlin, from 1783 to 1797, one-twelfth of the total mortality, according to *Casper*, was due to the same. In the fourth number of the 'Archivs der Aerzteund Seelsorger wider die Pockennoth' of the year 1798, *Von Junker* computes the deaths occurring from small-pox in the year 1796, among the 7,000,000 inhabitants of Prussia, at 26,646 (*Kussmaul's letters*). In the eighteenth century 30,000 died annually of small-pox in France. Of the resignation to the disease exhibited in the middle ages, a proverb of that time gives the best proof, 'From small-pox and love but few remain free.' *

The question arises, when considering that small-pox is so universally distributed over the world, as to whether there may not have been many points of origin for the disease, and that no locality can be properly selected as the one where it was primarily developed. There is no doubt that, under exactly the same conditions as were presented when the disease first made its appearance, small-pox may spring up independently of contagion. One writer has said: "It is evident that small-pox was either coeval with the creation, or had a subsequent beginning; and it is an inference deducable from the first principles of reasoning, that the same causes which originally produced, may reproduce it without contagion." †

Theoretically this idea may be true, but at the present time nearly all writers conclude that the disease is now only developed and spread by infection and contagion. Dr. Gregory, in reviewing this question, remarks: "The pathologists of the last century, from the time of Boerhave, reasoning from the very peculiar train of symptoms observed in small-pox, and from the comparative recent date at which it became known, adopted

*Curschmann Ziemssen's Cyclopædia, Vol II., p. 324.
†Col. Wilks' account of Southern India.

the notion that this disease is in all cases the product of a specific poison or contagion received in the blood from without. Such is still the general opinion of the best informed physicians. It can not indeed be denied that great difficulties are experienced in tracing the source of contagion in numberless cases, and that the doctrine of *spontaneous* origin admits of being supported by some ingenious and plausible arguments; but the weight of evidence is decidedly in favor of the invariable origin of small-pox by *contagion*."*

Considering the active contagiousness of small-pox and the frightful mortality which attended its development, it is no wonder that "astonishment and terror accompanied this affection in its progress, and men began to dread the extinction of the human race by such a cruel visitation" (Robertson). In the almost utter uselessness of all therapeutical procedures, there remained but one way by which the disease could be successfully combated, and attempts were made to discover a method by which its development could be resisted.

A strange operation is reported as being common in China during the first century: it was called *sowing* the small-pox, and consisted in snuffing powdered crusts, from small-pox patients, up the nose, or mixed with water they were placed into the nose, thus infecting the system with the disease. Shaw mentions that inoculation was practiced in India as early as the time of Christ. And Mr. Colden mentions in a work, which he published, that the operation was known to the Africans. He says: "I have lately learned from my negroes that it is a common practice in their country, so that seldom any old people have the disease. They generally inoculate all their young as soon as the infection comes into the neighborhood. They tell me, that in the regimen under it; they only abstain from all flesh meat, and drink plentifully of water acidulated with juice of limes." If the facts given above, as regards the performance of inoculation in China and India during the first century were clearly proven, it certainly would show that small-pox was a disease of antiquity; but there is much reason to doubt the truth of the writings referred to. "The early antiquities of China and India have become nearly synonymous with fable. In China the first appearance of small-pox is fixed by one authority, with specious accuracy, at 1122 years anterior to the Christian era, before which period it was unknown; and at least as remote an origin is claimed by the legends of India. In that country we find apparent indications of long experience in the treatment, rather than

*Cyclopædia of Practical Medicine, Vol. IV., p. 167.

the legendary history of the disease. That the presiding deity is a low bred goddess, whose temples are never approached by a Brahmin, and are frequented exclusively by the outcasts, furnishes little ground of inference; but the immemorial practice of the Brahmins of Orissa, near Ganjam, of inoculation by means of a sharp steel instrument, of exposure to the cool open air, to prevent the confluent disease, and even cold affusion for a day or two before the eruptive fever is expected, although indicative of successful experience, affords no evidence of antiquity beyond the sixth century."*

Inoculation was practiced in many countries before it was introduced into England. During the latter part of the seventeenth and early part of the eighteenth centuries, the process was employed in Turkey, Wales, Denmark, and other countries. Dr. Timoni, a Greek physician, has the credit of bringing the subject prominently before the medical profession. In a letter, dated 1713, to Dr. Woodward, he mentions the fact that, on the introduction of the operation into Turkey, it was rejected, but afterward was adopted. It seems that the physicians were willing to adopt the procedure, but it was difficult for them to induce the people to accept it. In England no one advocated its introduction until in the year 1717. Lady Whortley Montague, then absent from London, wrote a letter from Adrianople advocating very enthusiastically the adoption of the measure. Among other things she says: "The small-pox, so general, and so fatal amongst us, is here entirely harmless by the invention of *engrafting*, which is the term they give it. There is a set of old women who make it their business to perform the operation every autumn, in the month of September, when the heat is abated. People send to one another to know if any of their family has a mind to have the small-pox; they make parties for this purpose; and when they are met (commonly fifteen or sixteen together), the old women come with a nut-shell full of matter of the best sort of small-pox. Every year thousands undergo it, and the French Ambassador observes pleasantly that they take the small-pox here, by way of diversion, as they do the waters in other countries. There is no example of any one that has died in it, and you may believe I am well satisfied of the safety of the experiment, since I intend to try it on my dear little son. I am patriot enough to take pains to bring this careful invention into fashion in England."

Dr. Gregory gives the following account of the actual introduction of the operation into England. Speaking of Lady

*Col. Wilks' account of Southern India.

Montague, he says: "She kept her word, and to the spirit and enterprise of this lady, the introduction of inoculation into this country is due. It was not until her return to London that any attempt was made to profit by a discovery which had been announced for five years; and her daughter was reserved to be the first example of inoculation in England. This event occurred in April, 1721, and as its success was complete, Dr. Keith, who had been witness to the experiment, submitted his child to the same process, and with a like happy result. Several months elapsed, but the medical profession of London still remained sceptical; some because the practice originated with ignorant old women, and others from inability to understand the rationale of the process."*

In our own country Dr. Boylston introduced the process. During the year 1721, six deaths were reported, out of 244 persons inoculated in Boston. During the year 1722, two children of the Princess of Wales underwent the operation successfully, but about the same time several deaths occurred from the practice. This brought disfavor upon the operation in the eyes of both the profession and the public.

After years of experience it was found that, although inoculation most decidedly reduced the death rate among those upon whom it was performed, still the yearly mortality from small-pox was increasing. Moore, in his history of small-pox, states, "that at the beginning of the eighteenth century about one-fourteenth of the population died of small-pox: whereas, at the latter end of the same century, the number, notwithstanding, or perhaps, rather in consequence of inoculation, had increased to one-tenth; and this immense consumption of human lives was not the total evil, for many survivors were left with the partial or entire loss of sight, and with destroyed constitutions."

In the latter part of the eighteenth century, Baron Dimsdale published his work on "Inoculation for Small-pox." This was the last exhaustive treatise on the subject. Dr. Dimsdale was considered good authority, and inoculation gradually became more and more popular, notwithstanding small-pox was yearly increasing among the population. The slight risk of death was accepted by those who desired the operation, even with the knowledge that they themselves might be the media from whence the disease could spread, as readily as though they were suffering from natural small-pox.

It is this ability to spread the disease as readily through the community, from an inoculated case of small-pox, as from a

*Encyclopædia of Practical Medicine, Vol. IV., p. 172.

natural one, that should cause all to look with disfavor upon the operation. It is impossible to say what might be the practice at the present time, if the discovery of Jenner had not substituted a different and more simple mode of prophylaxis. Possibly inoculation could have been so practiced, under proper restraint, as to protect all from the spread of the disease. It is, however, unnecessary to consider the procedure as at all warrantable, since the protective power of vaccination has been fully demonstrated.

It is doubtful whether there has been a discovery made in the whole range of medical science, that has bestowed such a blessing on mankind, as the one which proved that the small-pox could be prevented by the substitution of another disease, of so mild a character that fatal consequences never followed its development.

For many years prior to the publication of the discovery of vaccination, a disease had been known in Gloucestershire, portions of Ireland and on the continent, as existing among cattle and horses. This disease so nearly resembled the variola in man, as to cause many to believe them to be one and the same. In 1745 and 1770 it appeared with such great severity in England that in the latter year King George III; at the opening of Parliament, called upon both Houses to give it their serious consideration (*Aitken*).

It was noticed that, whenever a severe epidemic of small-pox occurred, the cattle also were affected with a similar form of disease. Dr. Anderson, in his work on Fever, mentions the fact that, while small-pox was raging with great violence at St. Jago, on the west coast of New Grenada, to which a town named David, in Chiriqui, was situated about sixty or seventy miles to leeward, a few days (four or five), before the disease appeared in this latter town, the small-pox had attacked and destroyed many monkeys in the forest. Dying and dead monkeys were seen on the ground covered with the perfect pustules of small-pox; and several sick monkeys were seen on the trees, moping or moving about in a sickly manner. In the course of a fortnight one half of the inhabitants of the town of David were stricken with small-pox.* Sheep, also, are at times affected with a disease similar to the one above referred to. This disease is known in France under the name *clavelée*. The inhabitants of this country introduced the system of inoculation or clavelization into their affected herds, by which precedure many animals were saved, the disease being modified as in inoculation for small-pox in the human subject.

*Aitken, Vol. I., p. 399.

Diseases analagous to small-pox have been noticed running their course through pigs, dogs, and monkeys as has been previously mentioned.

It is difficult to prove that all these diseases are of common origin, yet it is very probable that they are the same modified by their occurrence in various animals. If they are not the same primarily, the fact certainly must be an anomalous one in the history of medicine, for in no other case does one disease prevent the occurrence of another in the same subject. An attack of measles never prevents scarlet fever, or small-pox render a person exempt from the ability to contract syphilis.

It was the immunity from small-pox, of those who had passed through the cow-pox disease, that led Jenner to study the subject of vaccination, and he was convinced that the disease first originated in the horse, and from thence was conveyed to the udders of cows by the hands of those who attended both horses and cows. Being developed upon the udders of the cows, the disease was subsequently conveyed to the hands of the milkers.

Dr. Jenner, to whom must be given the credit for making known to the profession and the world the prophylactic power of vaccination, published his first essay upon the subject in the spring of 1798, entitled "*An inquiry into the causes and effects of the Variola Vaccinæ, a disease discovered in some of the western counties of England, particularly Gloucestershire, and known by the name of cow-pox.*"

In the opening page of this essay, he says: "There is a disease to which the horse, from his state of domestication, is frequently subject. The farriers have termed it the *grease.* It is an inflammation and swelling in the heel, from which issues matter possessing properties of a very peculiar kind, which seems capable of generating a disease in the human body (after it has undergone the modification I shall presently speak of), which bears so strong a resemblance to the small-pox, that I think it highly probable it may be the source of that disease.

"In this dairy country, a great number of cows are kept, and the office of milking is performed indiscriminately by men and maid servants. One of the former having been appointed to apply dressings to the heels of a horse affected with the grease, and not paying due attention to cleanliness, incautiously bears his part in milking the cows, with some particles of the infectious matter adhering to his fingers. When this is the case, it commonly happens that a disease is communicated to the cows, and from the cows to the dairy maids, which

spreads through the farm until most of the cattle and domestics feel its unpleasant consequences. This disease has obtained the name of the *cow-pox*.

"Thus the disease makes its progress from the horse (as I conceive) to the nipple of the cow, and from the cow to the human subject."

Many writers since the time of Jenner have endeavored to prove that, although cow-pox and small-pox are analagous diseases, they are not identical. Dr. Gregory, while he admits that swine-pox and small-pox are alike, denies that cow-pox is the same disease. "In man," he says, "cow-pox never produces small-pox; nor does small-pox, however mild, approach to the character of cow-pox. It remains, therefore, a very questionable point whether these disorders can be essentially the same; in other words, whether cow-pox can be considered a permanent, as swine-pox is a temporary, modification of variola." He denies the power of implanting the vaccine disease upon the cow by miasmatic influence, and regards as "fabulous" the accounts, stating such had been done.

The first account given of a successful attempt to inoculate the cow with small-pox taken from a human pustule was published in Berlin, in 1801. Inoculation was afterward successfully performed by various persons, and in 1830, Dr. Sonderland communicated the disease to cows by covering them with blankets in which small-pox patients had lain. In 1836 a Russian physician, inoculated the udders of cows with human virus. From the vesicles so formed vaccination was performed, and retained its specificity throughout seventy-five transmissions through the human system.

Dr. Aitken, admits that "there are good grounds for the belief that the impalpable emanations, the specific effluvia, from cases of small-pox in human beings, have been sufficient to communicate the variolous disease to cows." He quotes the following fact as given by Mr. Ceely, in the *Transactions of the Provincial Medical and Surgical Association*:—

"At the village of Oakley, about sixteen miles from the town of Aylesbury, small-pox had been epidemic from June to October, 1840. Two cottages, in which three persons resided during their illness, were situated, one on each side of two sides of a long narrow meadow, comprising scarcely two acres of pasture land. One of these three patients, though thickly covered with pustules of small-pox, was not confined to her bed after the full development of the eruption, but frequently crossed the meadow to visit the other patients, a woman and a

child, the former of whom was in great danger, from the confluent malignant form of the disease, and died. According to custom she was buried the same evening; but the intercourse between the cottages across the meadow was still continued. On the day following death, the wearing apparel of the deceased, the bed clothes and bedding of both patients, were exposed for purification on the hedges bounding the meadow; the chaff of the child's bed was strewed about on the grass over the meadow, where it was exposed and turned every night, and for several hours during the day. This purification of the clothes continued for eleven days. At that time eight milch cows and two young heifers (sturks), were turned into this meadow to graze. They entered it every morning for this purpose, and were driven from it every afternoon. Whenever the cows quitted the meadow, the infected articles were again exposed on the hedges, and the flock of the bed was spread out on the grass, and repeatedly turned. These things remained until the morning, when the cows were readmitted, and the contaminated articles were supposed to be withdrawn. It appears, however, that the removal of the infected articles was not always accomplished so punctually as had been enjoined, so that, on one occasion, at least, the cows were seen in the midst of them, and licking up the flock of the bed which lay on the grass. These cows were in perfect health when first put out to graze in this meadow; but in twelve or fourteen days *five* (out of the eight) milch cows appeared to have heat and tenderness of the teats. The teats became swollen, and small hard papules could be distinctly felt upon them, as if imbedded in the skin. These papules daily increased in magnitude and tenderness; and, in a week or ten days, they rose into *blisters* (vesicles), passing into brown or blackish scabs. When the teats were in this condition, and very tender, constitutional symptoms of ill, health became developed. Sudden *sinking* or loss of milk, drivelling of saliva from the mouth, frequent inflation and retraction of the cheeks, staring of the coat, 'tucking up of the limbs,' 'sticking up of the back,' and rapid loss of flesh, were the appearances which even the peasants themselves were able to appreciate. By the middle of the third week the pustules were matured, and the crusts and loose cuticle began to be detached. The simultaneous occurrence of the disease on all the animals increases the probability of the operation of one common cause. The whole of the cows were certainly affected within less than three days of each other; and another circumstance requires particular notice, namely, the occurrence of the disease in a young heifer

(sturk), to which of course the disease could not have been communicated by those casualties which commonly propagate the vaccine variola among milch cows. The cause which originated the disease among them at the same time affected the young heifer which hitherto had not been considered liable to the vaccine disease, simply because no one had seen the animal affected by it. Now it is known, both in this country and in Germany, to be liable to the disease."

In the year 1799, Jenner published, "Further Observations on the Variolæ Vaccinæ," confirming the views set forth in his original essay, and in the following modest manner asking that they be received by the profession: "Ere I proceed let me be permitted to observe, that truth, in this and every physiological inquiry that has occupied my attention, has ever been the object of my pursuit; and should it appear in the present instance that I have been led into error, fond as I may appear of the offspring of my labors, I had rather see it perish at once, than exist and do a public injury."

In this essay, he presents the same views as regards the common origin of small-pox, and the similar diseases of animals, although he does not endeavor to fully settle the question. He says: "whether the cow-pox is a spontaneous disease in the cow, or is to be attributed to matter conveyed to the animal, as I have conceived, from the horse, is a question, which though I shall not attempt now to fully discuss, yet I shall digress so far as to adduce some further observations, and to give my reasons more at large for taking up an opinion that to some has appeared fanciful. The aggregate of these observations, though not amounting to positive proof, forms presumptive evidence of so forcible a kind, that I imagine it might on any other person have made the same impression it did on me, without fixing the imputation of credulity. First, I conceived this was its source, from observing that where the cow-pox had appeared among the dairies here (unless it could be traced to the introduction of an infected cow or servant), it had been preceded at the farm by a horse diseased in the manner already described, which horse had been attended by some of the milkers.

"Secondly, from its being a popular opinion throughout this great dairy country, and from its being insisted on by those who here attended sick cattle.

"Thirdly, from the total absence of the disease in Ireland and Scotland, where the men servants are not employed in the dairies.

"Fourthly, from having observed that morbid matter generated by the horse frequently communicates, in a casual way,

a disease to the human subject so like the cow-pox, that in many cases it would be difficult to make the distinction between one and the other.

"Fifthly, from being induced to suppose from experiments, that some of those who had been thus affected from the horse resisted the small-pox.

"Sixthly, from the progress and general appearance of the pustule on the arm of the boy,* whom I inoculated with matter taken from the hand of a man infected by a horse; and from the similarity to the cow-pox of the general constitutional symptoms which followed."

In a third essay published in 1800, Jenner still presents the idea that the two diseases were modification of the same: He says: "In my first publication on this subject, I expressed an opinion that the small-pox and the cow-pox were the same diseases under different modifications. In this opinion Dr. Woodville,† has concurred. The axiom of the immortal Hunter, that two diseased actions can not take place at the same time in one and the same part, will not be injured by the admission of this theory."

It is now three quarters of a century since the views given in the preceding quotations were published to the world, and to-day medical science has not succeeded in refuting them, or of adding any new demonstration to prove them correct. The very latest authority sums up the question in very much the same line of thought: "Respecting the origin of Variola Vaccinia, which is by no means a frequent disease, we have as yet no very certain knowledge. A 'spontaneous' development is accepted by many, upon no very strong evidence however. The inoculation of human small-pox lymph upon cows produces variola vaccinia, the same as after inoculation from the horse-pox, and if a susceptible person is vaccinated from a variola vaccinia acquired in this way, merely local pustules will be produced without any general eruption following. However strongly these circumstances speak in favor of the identity of human and cow, or animal-pox, for which many writers very zealously contend, they do not absolutely prove it: and hence, for the present, we can only admit the probability of the supposition that variola vaccinia is small-pox, so modified by the nature of the soil that it retains its tendency to strict localization, even when re-engrafted upon the human species."‡

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*A case reported in first essay.

†Then Physician to the London Small-Pox Hospital.

‡Curschmann.

As with all new theories, so it was with Jenner's discovery. Many simply ignored his publications, others made vigorous attacks upon him, while not a few came forward and apparently gave him their support, always however evincing that caution with which the medical profession receives any new and startling discovery. Even the great surgeon John Hunter failed to see anything in the new procedure that would warrant time for further investigation. Dr. Jenner, however, with the spirit of the enthusiast, studied the matter most persistently, as Aitken says, "with almost a holy reliance in the truth of the great discovery; and in the face of the most foolish opposition, he modestly continued to prosecute his inquiry, encouraged, as he said, by the hope of becoming beneficial to mankind."

Jenner himself felt most keenly the opposition shown him by the medical profession; for he says, in closing his third treatise on the subject, "The scepticism that appeared even among the most enlightened of medical men when my sentiments on the important subject of the cow-pox were first promulgated, was highly laudable. To have admitted the truth of a doctrine, at once so novel and so unlike anything that ever had appeared in the Annals of Medicine, without the test of the most rigid scrutiny, would have bordered upon temerity; but now, when that scrutiny has taken place, not only among ourselves, but in the first professional circles in Europe, and when it had been uniformly found in such abundant instances that the human frame, when once it has felt the influence of the genuine cow-pox, in the way that has been described, is never afterward at any period of its existence assailable by the small-pox, may I not with perfect confidence congratulate my country and society at large on their beholding, in the mild form of the cow-pox, an antidote that is capable of extirpating from the earth a disease that has ever been considered as the severest scourge of the human race."

The following year, in his fourth essay, he says, "that it is now too manifest to admit of controversy, that the annihilation of small-pox, the most dreadful scourge of the human species, must be the final result of this practice."

Notwithstanding all opposition, it was wonderful how rapidly the new operation gained favor with the public. In 1802 the House of Commons reported upon the utility of vaccination, and upon Dr. Jenner's claims to the discovery; and upon the 2d of June in that year, Parliament voted him £10,000. In 1807, this matter was reconsidered, and an additional sum of £20,000 was awarded him. In 1808, the National Vaccine Establishment was formed, which continued many years to

superintend, with much success, the practice of vaccination in this country (England). (*Dr. Gregory*).

The practice of the operation was introduced into America in 1799, by Benjamin Waterhouse, of Boston, he being the first Professor of Medicine in Harvard University. At first much opposition was shown by the public, and it was some time before the prejudice was so far removed as to allow of its becoming at all general.

Space would forbid a presentation of the views of prominent writers, who have both opposed and favored the operation since the discovery was announced. As has been intimated in the opening pages of this article, there still exists a prejudice in the minds of some practitioners as to the advisability of the procedure, but it is to be hoped that this number is small and that very soon there can be none found who oppose its general adoption. Dr. Aitken thus forcibly compares the ready acceptance of former times with doubtful reception of later years: "Then it would seem to have been almost unanimous; and now, one would think, at first sight, that it were almost an insult to human understanding, to be obliged to collect statistics to *prove* that vaccination confers a large exemption from attacks of small-pox, and almost absolute security against death from that disease. But so it is, and independently of the information which such statistical inquiry is calculated to convey to those who advise our lawgivers and public administrators, the inquiry is eminently useful in relation to everything which bears on the nature of vaccine and variolous disease. The general ignorance of the community, and especially the prejudices of the lower classes, and not a few (even medical men) who ought to know better as to the value, the aim, and the object of vaccination, is lamentably great, and has still to be overcome."

It is pleasant to observe that the discoverer of this wonderful boon to mankind, received some recognition for the great discovery he had been able, by years of constant application, and unrequited toil, to so completely elaborate, in the three or four essays which followed each other in rapid succession. It will be found by a careful perusal that the many questions connected with the processes of vaccination and revaccination were as ably discussed in these short essays, as has been done in the elaborate articles which have followed by more moden writers. The recognition of the greatness of the discovery by the Houses of Parliament, in granting the large sum of £30,000, is something exceptional in the history of medical investigation and discovery. As satisfactory as this

recognition on the part of his Government must have been to Jenner, he received, no doubt, much greater pleasure in being able to see that gradually all opposition was being overcome, and his discovery was being encouraged by the medical profession, throughout the civilized world. In one of his essays, he says: "Since my former publications on the vaccine inoculation, I have had the satisfaction of seeing it extend very widely. Not only in this country is the subject pursued with ardour, but from my correspondence with many respectable medical gentlemen on the continent (among whom are *Dr. De Cano*, of Vienna, and *Dr. Ballborn*, of Hanover), I find it is as warmly adopted abroad, where it has afforded the greatest satisfaction. I have the pleasure, too, of seeing that the feeble efforts of a few individuals to depreciate the new practice, are sinking fast into contempt beneath the immense mass of evidence which has risen up in support of it."

It is proposed, in the following pages of this article, to as briefly as possible consider the various questions which arise in a careful study of the whole subject of the operation of vaccination. In order that the matter may be systematically presented, it is considered advisable to arrange the whole subject, and study it under the four following queries:

First. Does vaccination protect the system from contagion of small-pox?

Second, Why does the protective power of vaccination become so impaired as to render revaccination advisable?

Third. What causes have prejudiced the public against the operation of vaccination?

Fourth. What measures should be instituted to enforce a due appreciation of the benefits of vaccination?

First—Does vaccination protect the system from the contagion of small-pox?

In private practice the difficulty of collecting statistics, as regards the number of those who have suffered from small-pox, after vaccination is so great, that no reliable information can be gained from consulting such figures, it is evident that in some cases varioloid has occurred, where the patient presents good cicatrices on examination. The occurrence of modified small-pox in those who have been vaccinated has caused many, who have not inquired carefully into the subject, to doubt whether the operation is really one of prophylaxis. A case of *varioloid* occurring in a community, will spread small-pox as

readily among the unvaccinated as will a case of the unmodified disease. This fact being known, the ignorant are led to decry vaccination and to resist the attempts of the physician to institute the procedure.

It is evident that much knowledge of the protection guranteed by vaccination may be gained by consulting the mortality tables of any country. By comparing these tables it will be found that deaths from small-pox have decreased, in a wonderful degree, since laws compelling attention to the subject of vaccination, have been enacted. The records of the Army and Navy also illustrate the beneficial results accruing from compulsory measures.

Dr. Seaton, in reporting the results of vaccination in Scotland and Ireland, says, that in the twelve years from 1853 to 1864 there was an annual death rate from small-pox in the former country of 1,054, there being no vaccination act prior to 1863. In the years 1865, '66, '67, '68 it was, respectively, 175, 200, 124, and 25. In Ireland from 1830 to 1840, the annual average mortality was 5,800; from 1840 to 1850 it was 3,827, and from 1850 to 1860 it was 1,272. Vaccination became compulsory in 1863 and in the years 1864, '65, '66, '67, '68, they were, respectively, 854, 347, 187, 20, and 19. In the first three months of 1869 there were only three deaths, and in the next quarter of the year, none. [*Edinburgh Medical Journal*, *November*, 1870.

The report of the Epidemiological Society of London is given quite fully by Prof. Aitken, and, although quite lengthy, its introduction will certainly not be out of place here, as it shows very conclusively the beneficial influence of even an imperfect enforcements of vaccination enactments:

"I. To prove the influence of vaccination in England, it is shown that out of every 1,000 deaths in the half century from 1750 to 1800, there were 96 deaths from small-pox; and out of every 1000 deaths in the half century from 1800 to 1850, there were only 35 deaths from small-pox.

"II. To prove the influence of vaccination on the Continent, it shows that in various German States sufficient evidence can be obtained to show that one out of every 1,000 deaths *before vaccination was used*, 66.5 were deaths from small-pox; but that out of every 1,000 deaths *after vaccination* came into use, the deaths from small-pox were only 7.26.

"III. To prove that in countries where vaccination is most perfectly carried out small-pox is least mortal, it is shown that

(*a*) In this country where vaccination has been voluntary, and frequently neglected, the deaths from all causes being 1,000, *the deaths* from small-pox were as follows:

London,	16.	Edinburgh,	19.4
Birmingham,	16.6	Glasgow,*	36.
Leeds,	17.5	Galway,*	35.
Eng. & Wales	21.9	Limerick,*	41.
Perth,	25.	Dublin,	25.6
Paisley,	18.	Connaught,*	60.

All Ireland, 49.

(*b*) In other countries, where vaccination has been more or less compulsory, the deaths from all causes being 1,000, the deaths from small-pox were as follows:

Westphalia,	6.	Bohemia,	2.
Saxony,	8.33	Lombardy,	2.
Rhenish Prov.,	3.7	Venice,	2.2
Pomerania,	5.25	Sweden,	2.7
Low. Austria,	6.	Bavaria,	4.

As early as the year 1803, a law was enacted in Sweden, by which vaccination was made compulsory. The King, out of his own purse, appropriated money "*to be divided into premiums, which were to be distributed* among such medical men as could exhibit the greatest number of vaccinated persons." The result of this active endeavor to popularize the procedure, is told in the report written from Stockholm in 1814, by *Dr. Fr. Hedin, First Physician to the King*, He says: "It may, therefore, be asserted that the small-pox, that equally disgusting and destructive pestilence, which for many ages continued annually *to send out of the world an immense number of young children, is now, through the influence of Dr. Jenners' inestimable discovery, so perfectly extirpated in Sweden, that it never can become epidemic, even at any time, notwithstanding all the orders and all the vigilance employed for its seclusion, the infection should make its appearance.* Such, in the last twelve years, has been the effect of the King's wise and humane attention, of the unanimity and disinterestedness of the medical profession, of the patriotic zeal of the clergy, of the good examples so promptly exhibited by the upper classes, and of the progress of information and civilzation in the lower."

This wonderful protective power of vaccination is conclusively shown in the Army and Navy reports of various countries. Of course, where the medical regulations are as strictly enforced as they are under military discipline, it would be expected that

*It has been clearly shown by good authority that in towns marked with he asterisks, the great mortality was due to neglect in vaccination.

the full benefits of any procedure would be observed. Dr. Balfour has collected statistics from the records of the British Army and Navy. It is shown that in one branch of the service, with an aggregate strength of 44,611 during the twenty years from 1817 to 1836 inclusive, there were only THREE deaths from small-pox, in a total mortality of 627. During the same period among the troops of Gibraltar, the aggregate strength being 44,611, and a total mortality of 1,291, there occurred only ONE death from small-pox. In the same period, the aggregate strength of the troops of the West India Islands being 86,661, the total mortality from all causes was 6,803, and there was not a single death from small-pox in this whole number. At the same time, among the black troops on the same islands, with a strength of 40,934, and a mortality of 1,645, there was not a death from small-pox. This exemption is the more remarkable as there were several epidemics of the disease during this period, and it is well known that the colored race is peculiarly predisposed to this particular contagion. At Bermuda, Nova Scotia, New Brunswick, Cape of Good Hope, and the Mauritius, there were no deaths from small-pox for twenty years. And in Western Africa, where the unprotected population was dying by hundreds, there were no deaths from the disease among the troops stationed in that region of country. The most remarkable exemption is found in the reports from Malta. There was an aggregate strength of the British troops of 40,826 during the period from 1818 to 1838 inclusive; with a total mortality of 665, only two deaths from small-pox occurred. During the years 1830 and 1838, extensive epidemics of small-pox swept over the island, in which 1,169 persons were destroyed. The mortality was 1 in 4.7 among those who were *not vaccinated*; 1 in 23.4 among those who were *supposed to be vaccinated*; and among those who were attacked the second time with small-pox, the rate of deaths was 1 to 10.8. In the year 1830, the native population of Malta was 100,839 persons. It is shown that 1 in every 12.1 was attacked with the disease, and that 1 in every 85 persons died. Among the troops, including the wives and children, there was only 1 in every 188 attacked, and of these only 1 in 682 died from the disease. (*Aitkin*).

Mr. Marson, of the Small-Pox Hospital, London, reports, "That in 5,000 cases of small-pox, under observation from 1836 to 1855, it appears that there were thirty-five per cent. of deaths among those that were unvaccinated." The same writer says that in the town of Pinchbeck, Lincolnshire, with a population of 3,000 inhabitants, during thirty years there

was only one death from small-pox, and that was an unvaccinated person. Dr. Seaton, in his evidence before the select committee, stated that the mortality among children under five years of age had been reduced, by vaccination, in Scotland, from 70 or 80 per cent. to 55. In Greenoch the mortality in the same class had been reduced to 36 per cent., and in Glasgow to 28 per cent.—(*Edinburg Medical Journal for November*, 1871.

During the years 1871 and 1872 the city of Philadelphia was visited with an epidemic of small-pox, noted for the great mortality with which it was attended. Dr. Wm. M. Welch, of that city, has furnished a most valuable report of the epidemic, comprising statistics of 2,377 cases of variolous disease, which occurred under his observation. In this report he classifies all cases occurring in unvaccinated persons, as well as those cases where, even after vaccination, the eruption passes the sixth or seventh day without reaching maturity, as true variola. All other cases he calls varioloid.

The following tables show conclusively the protective influence of vaccination, and are taken from the report above referred to:

"Table showing the total number of cases of variola and varioloid admitted to the hospital during the epidemic; also, the number of deaths and death rate of each:"

DISEASE.	ADMITTED.	DIED.	PER CENT. OF DEATHS.
Variola	1,301	728	65.95
Varioloid	1,076	15	1.39
Totals	2,377	743	31.25

"Table showing the diminished mortality from small-pox after vaccination:

	ADMITTED.	DIED.	PER CENT. OF DEATHS.
Not vaccinated	697	449	64.41
Post vac. cases	1,629	276	16.94
Unclassified	51	18	
Totals	2,377	743	31.25

The death-rate of this report is certainly very high. As a rule, 33 per cent. is considered the average mortality from the disease during an epidemic of small-pox. As seen by the

tables above, a much greater average is shown. This higher rate of mortality is noticeable in both post vaccinal and unvaccinated cases, but the difference between the two classes is great, and when it is remembered that persons who presented very poor cicatrices are considered among the vaccinated, the difference is still more marked. The author assigns as a reason for this great mortality, "First, the virulence of the epidemic; second, that a large proportion of the patients were from among the lower order of society, with constitutions exhausted, and perverted by intemperance—and many of these were not received until all hope of recovery had passed."

It is shown conclusively, by facts deduced from the testimony given in the foregoing pages, that, since the introduction of the operation of vaccination, the rate of mortality has certainly been reduced in those portions of the world where attention has been given to the enforcement of the operation; and the tables of Dr. Welch also show the influence upon small-pox itself by proper attention to the procedure. In those cases which occur after vaccination, known as cases of varioloid, the death-rate is insignificant, and the mildness of the attack is well known by all. Mr. Simon has calculated that the death-rate from small-pox among the vaccinated varies from an inappreciable small mortality to 12½ per cent.; that among those who are not protected by vaccination, the death-rate ranges from 14½ to 53 4-5 per cent. (*Aitken*). According to Mr. Marson, the average mortality from small-pox amongst the vaccinated is 5.24 per cent.; but if the operation has been perfectly performed, the mortality is reduced to les than *half of one per cent.*

According to Drs. Gregory and Heim, the ratio of mortality after vaccination is about the same in England and Germany, namely, 7 per cent. In France, according to the report of M. Villenuve, it appears to be much smaller. Of 365 cases of small-pox, occurring in persons who have been successfully vaccinated at some previous time, only eight proved fatal, giving a proportion of about one in forty-five or forty-six. More recently, M. Gaulthier de Claubry infers that varioloid destroys one in one hundred, while the mortality from small-pox is one in 8.5.—(*British and Foreign Medical Review*, January, 1839.)

This line of investigation might be pursued much further if considered necessary, but the testimony given in the preceding pages is certainly sufficient to clearly demonstrate to any one that, as a means of preventing the development of small-pox, vaccination is all that could be desired. Jenner's idea has not

been fully realized. In his petition to Parliament, in 1802, he stated that he had "discovered a disease attended with the singularly beneficial effect of rendering, *through life*, the person inoculated with it perfectly secure from the infections of small-pox." The question, which may arise in discussing the reasons why such a perfect exemption has not yet been obtained, will be considered in the pages which are to follow.

SECOND.—WHY DOES THE PROTECTIVE POWER OF VACCINATION BECOME SO IMPAIRED AS TO RENDER REVACCINATION ADVISABLE?

Although Jenner considered that he had discovered a disease which being once implanted would render the person so inoculated, perfectly secure "*through life*" from the invasion of small pox. It was but very few years before the question was considered as to whether the influence of the vaccine virus would not so completely die out as to afford no protection. It was impossible to reach any conclusion in regard to the question in the brief time in which Jenner presented his essays to the world. But in his third treatise he mentioned the fact that some were even then wondering if the security obtained by the operation was temporary or otherwise.

"Some there are," he says in his third essay, "who suppose the security from the small-pox, obtained through the cow-pox, will be of a temporary nature only. This supposition is refuted not only by analogy with respect to the habits of diseases of a similar nature, but incontrovertible facts, which appear in great numbers against it. To those already adduced in the former part of my first treatise, many more might be adduced were it deemed necessary; but among the cases I report, one might be found of a person who had the cow-pox fifty-three years before the effects of the small-pox was tried upon him. As he resisted it, the intervening period I conceive must necessarily satisfy any reasonable mind. Should further evidence be thought necessary, I shall observe that among the cases presented to me by Mr. Fry, Mr. Darke, Mr. Tierny, Mr. H. Jenner, and others, there were many whom they inoculated ineffectually with variolous matter, who had gone through the cow-pox many years before this trial was made."

The cases Jenner referred to in the above where persons who had been inoculated directly from the cow, many years previous to the time at which an attempt was made to introduce the small-pox poison into the system. He mentioncd that he purposely selected the several cases in which the

disease had appeared at a very distant period previous to the experiments made with variolous matter, to show that the change produced in the constitution is not affected by time.

In all the attempts made to inoculate small-pox when the effects of the cow-pox virus had been previously experienced, he mentions that some local effect was manifested; but denies that there were any symptoms that would indicate that the general system had been disturbed. He says: "It is remarkable that variolous matter, when the system is disposed to reject it, should excite inflammation on the part to which it is applied more freely than when it produces the small-pox. Indeed it becomes almost a criterion by which we can determine whether the infection will be received or not. It seems as if a change, which endures through life, had been produced in the action, or disposition to action, in the vessels of the skin; and it is remarkable, too, that whether this change has been effected by the small-pox or cow-pox, that the disposition to sudden circular inflammation is the same on the application of variolous matter."

It was not long, however, before cases of small-pox occurring after perfect vaccination were so frequently noticed by practitioners, that the fact of absolute security from the disease by the adoption of the operation was not considered substantiated. Through the published statements of Jenner and others, the public had been led to believe that by submitting to the inoculation of cow-pox they would be exempt for all time from the dreaded pestilence. As one and another of these cases of post vaccinal small-pox occurred, many began to doubt the efficacy of the procedure, and resisted its adoption. As early as the year 1818, the College of Physicians, of London, in a report made to Parliament, stated that "The security derived from vaccination against the small-pox, if not absolutely perfect, is as nearly so as can perhaps be expected from any human discovery; for amongst several hundred thousand cases, with the results of which the College have been made acquainted, the number of alleged failures have been surprisingly small; so much so, as to form certainly no *reasonable objection to the general adoption of vaccination; for it appears that there are not nearly so many as there are deaths in an equal number of persons inoculated for the small-pox.*"

In Scotland a great alarm was created during the year 1813, because of the appearance of small-pox which prevailed in portions of that country; many who supposed themselves protected by vaccination were seized by the disease. The fear that it would again ravage the earth, induced the

people to request a report from the physicians and surgeons residing in the neighborhood of the epidemic. These reports invariably showed that the disease was so modified by the previous vaccination, that there were no dangerous or fatal results; and in the whole British Empire not a single death had ensued from it.

In the summer of 1818, the following appeared in a Dundee newspaper: "For nearly twenty years the valuable discovery of Jenner, it is almost universally admitted, had banished the small-pox from this island; of late, however, it is painful to state, this dangerous malady has again assumed an epidemic form, and has committed considerable ravages in many parts of Britain.

"Dundee has not been exempted from its share of this severe visitation, as at this moment the small-pox prevails extensively, in a form quite unequivocal, *without altogether sparing even those who had undergone the cow-pox in a distinct and satisfactory manner.* This has spread alarm among all clases of people, and has excited the attention of the Governors of the Infirmary, who at their last general meeting, on the 8th of September last, nominated a committee, consisting of David Blair, Jr.; Alex. Ramsay, M. D.; Alex. Stormouth, M. D.; and John Crichton, Esq., Surgeon, to report on this interesting subject; and particularly to point out what confidence may yet appear due to the preventive power of vaccination, and whether any means hitherto not generally adopted, may tend to render these more effectual.

"These gentlemen, in compliance with this request, have submitted the following observations to the weekly committee, which was ordered by them to be published in the Dundee newspapers."

The report, though very interesting, is too lengthy to be given in full, but the following is a condensed epitomy of the whole:

1. "That vaccination has failed to prove a perfect security against the contagion of small-pox in an epidemic form; but that there exists a marked difference in the disease as developed in a person previously vaccinated, in some cases so mild as to hardly deserve the name of disease. On the other hand, many have died from small-pox who have never been inoculated with small-pox or cow-pox.

2. "Cases of distinct small-pox have occurred, following apparently perfect vaccination. None of these cases have proved fatal.

3. "The virulence of the present contagion is shown by occurrence of small-pox a second time in the same individual.

4. "It does not appear that there is any ground for the assertion that the preventive influence of cow-pox diminishes by lapse of time, or ceases altogether to exist. Many interesting facts have come to our knowledge in the course of this epidemic, which are at complete variance with this opinion.

5. "There can be little doubt that much must depends upon careful selection of the matter for vaccination, and upon observing the regular process of the pustule through its different stages, as characterized by the best writers on this subject.

6. "As no danger, whatever, attends the practice of vaccination, and as it evidently mitigates in a most extraordinary manner the severity of small-pox, where it fails to prevent, altogether, its attack, we are fully warranted to recommend, in the strongest manner, the continuance of a practice which has hitherto proved so great a blessing."

It is apparent, that at as early a date as the year in which the above report was published, a modified form of small-pox had been observed, and its peculiarities made known to the profession. For a time, some writers considered that varicella or chicken-pox was a modified form of small-pox; this idea, however, was soon proved to be incorrect, and the two were shown to be distinct diseases. It was, however known that cases of small-pox occurred more than once in the same individual; and instances have been given where the disease had occurred as many as three, five, or seven times in the same person. Generally, when it does so recur, the second attack is modified by the first to such an extent as to be a comparitively trivial affair, although, in some instances, the second is much more serious than the first, and may even result fatally.

This same development of modified small-pox occurs sometimes after successful vaccination. When thus presenting itself, it is generally so mild in character as to be scarcely noticed by the patient, two or three pustules being all that are developed. In such cases, the attending physician is sometimes greatly troubled to make out a diagnosis.

There are, however, exceptional cases following vaccination, as in second attacks of small-pox, when the disease, in all its symptoms, so nearly approaches true small-pox that it becomes almost impossible to state whether the disease is at all modified.

The term varioloid has been given to this modification of variola. This is evidently a misnomer, as the two forms are but modifications of the same disease, and are not to be

considered in any way distinct in character. As regards the frequency of the occurrence of varioloid after small-pox, compared with that following vaccination, most writers consider that there is not much difference, there being fully as many second attacks of small-pox as of post vaccinal cases. Of late years, however, there seems to be an increase in the number of varioloid cases occurring after vaccination; this is scarcely to be wondered at, as it is proven that the influence of vaccination does eventually die out, after having been once performed; and there comes a time when the individual so unprotected, when exposed to the contagion, will as readily contract the disease as if vaccination had not been performed.

There are certain epidemics, in which it becomes possible to revaccinate with success a much greater per centage of cases than at other times. Dr. W. B. Davis, in an article published in the Lancet and Observer for February last, demonstrates that the susceptibility to revaccination is shown in at least 75 per cent. of those operated upon, that number "taking" the disease as perfectly as if no primary vaccination had been undergone.

This susceptibility is in no wise exceptional, and such a fact cannot be too strongly urged as a reason why revaccination should be insisted upon.

Dr. Frank P. Foster, in the close of his report to the New York Dispensary for 1873, says: "I would also call attention to the great proportion of successful *revaccinations*, and insist that these figures are not to be taken as exceptional, but that in *general* a much greater degree of success ought to be attained in revaccinations than the profession at large seem to expect. In August last, I had the opportunity of bringing these results to the attention of the Public Health Section of the British Medical Association, and I was then much gratified to hear Dr. Grieve, who was in charge of the Hamstead Hospital during the last epidemic of small-pox in London, express the same view."

The question arises, that if the protective power of vaccination does die out in an individual, is it possible to again give protection by a revaccination, and, if so, is it also possible to determine a definite time at which such a procedure should be insisted upon?

Such authorities as Aitken, Niemeyer, and many others equally prominent, consider that there is no doubt but that vaccination protects the individual for a limited time only. The former writer says: "Since vaccination has been generally practiced, it has now and then seemed apparent that the protective power of vaccination becomes gradually weaker,

and at length dies out in the individual." Niemeyer concluded that "The protection against variola afforded by vaccination is for a far shorter period than is generally believed." Dr. Copeland mentions: "That he saw and describes as early as 1823, small-pox as it affected members of the same family, at different periods after vaccination, and in young persons who had been vaccinated only ten or eleven years. Contrasting such cases, he found that the severity and fully developed condition of small-pox was generally in proportion to the length of time which had elapsed from vaccination."—(Aitken).

The period for which protection is guaranteed by a successful vaccination may be longer or shorter, when many individual cases are under consideration. It is impossible to positively determine the time in each case, when the protective power of vaccine virus has completely died out. By experiment it has been discovered that there comes a time, in the life of every individual, who has previously undergone the operation, with scarcely an exception, when the system may be again brought completely under the effect of the virus, introduced by a vaccination. All the local and general symptoms in no wise differ from those observed in a primary vaccination. As has been previously stated, of late years there has been a marked increase in the number of varioloid cases occurring during any epidemic of small-pox. In some instances, this development of the disease may be traced to a poor primary vaccination, but in many others there is no doubt but that the cause lies in the time which has elapsed since the operation was performed. Dr. Welch fully considers this portion of the subject in the report of the Philadelphia Municipal Hospital, to which reference has already been made. He concludes in closing this portion of the subject, in these words: "We have adduced, we think, facts sufficient to prove that the susceptibility to small-pox, which is destroyed for some years in vaccinated persons, returns, and progressively increases, (up to a period undetermined) with the distance of time from the primary vaccination. The logical inference then is, that revaccination will exhaust the returning susceptibilty to small-pox. Fortunately this is not only beautiful in theory, but has been found to be the fact, as existing records show, whenever revaccination has been carefully practiced. The rare occurrence of death from that disease after the latter places its practical efficacy beyond question. Revaccination is not to be recommended only, as some suppose when the primary vaccination has been imperfect, but to all persons, irrespective of the character of their cicatrices; for it is now fully estab-

lished, that a typical vaccine scar is not proof of the immunity of the individual from small-pox. * * * * * * We are fully prepared to earnestly and cordially recommend revaccination, as a most necessary supplemental measure to the primary vaccination."

Dr. Aitken publishes the following, taken from various Army reports: "In 1833 between 40,000 and 50,000 adults were revaccinated in the Prussian Army, and in about 33 per cent. of the entire number the revaccination "took" with perfect success. Amongst the Russian soldiers at Kasan, the rate of perfect success was about 18 per cent. In the army of Denmark, from 1843 to 1847, nearly 20,000 revaccinations were practiced, of which more than half were attended with perfect success, and more than a quarter with modified success.

"Since 1843, revaccination has been compulsory in the Bavarian army. From that date till 1857, not even a single death from small-pox has occurred, nor even a single death from unmodified small-pox. Similar good results have followed the institution of revaccination in the Danish army; the army of Sweden, of Baden, and in the British army also, according to Dr. Balfour's interesting report for 1859. So great indeed is the practical importance of revaccination, that in the British army a departmental order was issued by circular, of date 21st of September, 1858, and is at present in force, which ordains that every recruit, without exception, on joining the headquarters or depot of the corps or regiment to which he belongs, shall be vaccinated, even if he should be found to have marks of small-pox or previous vaccination, and that a monthly return of the results, as to (1) a perfect vaccine pustule following the operation, or (2) a modified one, or (3) a failure shall be forwarded to the Director General."

From reports made by Mr. Simon, as regards revaccination in various armies, the following extract is taken as it appears in a paper published in the volume of United States Sanitary Commission, on the subject of "Vaccination in Armies:" "On the average of more than 14,000 experiments (an immense majority performed at ages between twenty and thirty years), 34 out of every 100 persons revaccinated developed the same sort of vesicle, as would arise from a first insertion of vaccine lymph. And, it is important to observe, this renewed susceptibility to cow-pox did evidently not depend, so far as could be traced, on any original ineffectiveness of the former vaccination; for (as is expressly set forth in the second part of the table) among the 14,384 subjects of vaccination, there were 7,845 who presented strictly normal scars of previous vaccination. Yet, nearly a third of this large number

gave again exactly such phenomena as arise in children when vaccinated for the first time. It does not follow from this, however, that every third man would have taken the small-pox if exposed to the contagion, but that they would have been *endangered* admits of no doubt."

	Total.	Ratio of success per 1000 cases vaccinated.		
		Perfect Success.	Modified Success.	No Success.
Vaccination of Wirtemburg Army, in the five years, 1831½-1835½	14.384	340.2	260.8	411.5

It is to be regretted that it has been impossible to find any statements as regards vaccination in our own army during the late war. The only report that has come to hand, is one furnished by Dr. S. O. Vanderpoel, Surgeon-General of New York, and is published in the sanitary reports previously referred to. This report consists of the returns made to him in accordance with a general order.

Total number of recruits examined with reference to vaccination	9,548
Number of persons bearing marks of previous vaccination	7,765
Total number vaccinated or revaccinated	8,095
Total number vaccinated who were found susceptible	2,292
Number of susceptible persons who had marks of previous vaccaination	1,338

From this report it appears that a little more than one-sixth of those who bore marks of vaccination, were, at the time of examination, susceptible to the disease.

There is much greater difficulty experienced in determining the time at which vaccination should be performed, than in demonstrating that the operation itself is desirable and necessary. There is, in fact, no practical manner by which it can be positively demonstrated that the protective power is unimpaired, in any individual case, unless the experiment is made of introducing the virus a second time into the system. In private practice it is impossible to make any extended experiments to determine the matter; the only reliable data that can be taken, authoritatively, are the carefully prepared reports of small-pox hospitals, extending over a long period of time. There are certain periods of life which appear to be especially pre-disposed to small-pox contagion, and it is a fact, that a greater mortality attends the disease when occurring in the extremes of life—infancy or old age. This should, therefore, be remembered when the amount of protection given by a

previous vaccination is being considered; evidently that vaccination which would amply protect during middle life would not exert sufficient power to render the individual secure during the periods mentioned as being particularly disposed to the disease.

In the valuable article furnished by Drs. F. G. Smith and Alfred Stille, to the Sanitary Commission, entitled "Vaccination in Armies," mention of which has already been made, the following extract occurs as taken from the work of Mr. Simon: *

"Mr. Simon states that in Paris nearly one-third of the whole number of deaths from small-pox occurred between the ages of twenty and thirty, indicating, as he remarks, an appalling amount of post-vaccinal small-pox.

"He further states that what chiefly attracted attention was, that persons who had been vaccinated ten or fifteen years ago, and who during this interval had, perhaps, repeatedly resisted small-pox, would at length yield to the infection in a certain proportion of their number. This had most frequently happened during the times when small-pox was severely epidemic among the unvaccinated; and when large masses of persons with vaccination of many years were exposed to the test of a strong epidemic influence. Under this ordeal it became evident that for some vaccinated persons the insusceptibility conferred by cow-pox was not of life duration; and from a careful analysis of cases, that this lessened security of certain vaccinated persons bore at least some proportion to the number of years which in each case had elapsed since vaccination. For there were not materials to prove any uniform rate of increase from year to year; and the increase, such as it was, apparently continued up to thirty years of age; after which period it seemed that the liability to contract small-pox underwent a continuous decline. Thus, Professor Heim, taking 1,055 cases of modified or unmodified small-pox in vaccinated persons, distinguished them under thirty-five heads, corresponding generally to the thirty-five years which had elapsed since vaccination. When this is divided in three successive parts, one for the *first twelve years* after vaccinations, one for the next *seventeen*, and one for the *following six years*. It appears that the average number for each year is, in the first division, twelve; in the second division, forty-eight; in the third division fifteen. A calculation of similar materials made by Professor Retzius, with respect to 961 cases in the Stock-

*Papers relating to the History and Practice of Vaccination presented to Parliament by command of her Majesty. 1857.

holm hospital, gave the following series to express the average allotment of small-pox to each year of life in eleven successive quinquennials, up to the age of fifty-five: 3 1-5, 4 2-5, 13 1-5, 45 2-5, 51 3-5, 40, 20, 17 3-5, 3 4-5, 2 1-5, 1.

Mr. Maison, who had been for twenty years resident surgeon of the small-pox and vaccination hospital in London, says in a petition to Parliament:

"But few patients under 10 years of age have been received with small-pox after vaccination. After ten years the number began to increase considerably, and the largest admitted are for the decimal period from the age of fifteen to twenty-five; and although progressively diminishing, they continue rather large up to thirty; and from thirty to thirty-five they are nearly the same as from ten to fifteen; but as in the unprotected, at this period of life the mortality is doubled; showing the cause to be probably as much or more depending on age and its concomitants as on other circumstances. In still further advanced life, the rate of mortality will seem to increase also, as in the unprotected state. But this tendency may be in a considerable degree counteracted, there is little doubt, by giving more attention than has hitherto generally been given to the perfection of the process of vaccination.

Professor Flint considers that "there is no known law governing the duration of the protective influence of a single vaccination. Probably the duration varies widely in different persons, and some persons are protected by one vaccination for life. Some have thought that vaccination ought to be practiced as often as every three years; and others that an interval of twenty years or more is allowable. It is evidently better that the period should be needlessly short than too long. With our present knowledge, the propriety, if not importance, of revaccination every five years is to be advocated. In case of known exposure, or where small-pox prevails as an epidemic, it is proper to revaccinate without regard to previous vaccination; in fact, it is always proper as the readiest and safest test of insusceptibily to small-pox."—[*Practice of Medicine, Page* 906.]

Prof. J. Lewis Smith remarks that "The longer the period after the first vaccination, the greater the number of those in whom a second vaccination is effective; and, as has already been intimated, the greater also the liability to the variolous disease if a second vaccination is not performed. It is recommended, therefore, to perform a second vaccination, not later than the sixth or eighth year, and again in childhood; and if small-pox is epidemic it is proper to vaccinate all who

have not been vaccinated within three or four years."—[*Diseases of Infancy and Childhood, p.* 222.

Many authorities agree that a perfect vaccination almost positively protects the system up to the period of puberty, at which time a successful revaccination may be performed. As the age of puberty varies with each individual, this statement is a very indefinite one upon which to base any theory; and may include the period from twelve to eighteen years, varying in each individual case. It is probable, however, that this change does to some extent influence the protective power of vaccination performed in infancy; but it is equally as probable that the time intervening between the primary vaccination and puberty, has much more to do with the renewed susceptibility than the systemic change completed in puberic development.

The experience derived from observation in small-pox hospitals, does not show that the protective power of vaccination is in all cases perfect up to the age of puberty, or fourteen to seventeen years. It is, however, noticeable that when an attack of small-pox does occur before that time, the accompanying phenomena are generally modified to a great extent by the vaccination previously performed. In an article published in the London Lancet of April 8, 1864, the following remark is made: "Not a single revaccinated case has been admitted into the small-pox hospital at Homerton, and no death of a vaccinated person under seventeen. This shows the protective power of even imperfect vaccination up to puberty, and the necessity of revaccination at this time."

Meigs and Pepper, in closing an article on the vaccine disease, say: "The only remaining point for consideration is the period of life at which revaccination ought to be performed. The prevailing opinion seems to be that somewhere about puberty is the most suitable time; unless in the cases of children exposed immediately to the infection of the disease, when it may and ought to be resorted to at a much earlier period.

Dr. Welch has published tables which are valuable in this connection, and are taken from the report of the Philadelphia Municipal Hospital previously referred to. The first table "shows the degree of protection which vaccination confers to the age of puberty;" introducing for comparison the unvaccinated cases. The second table shows "the protection conferred by vaccination up to the age of puberty, as compared with the protection subsequent to that period."

TABLE.

Showing the degree of protection which vaccination confers up to the age of puberty.

		Admit'd.	Died.	Per ct. of deaths.
Under one year of age.	Not vaccinated	24	20	83.33
	Vaccinated *less* than 7 days previous to the appearance of the eruption	6	5	83.33
	Vaccinated *more* than 7 days previous to the appearance of the eruption	5	2*	.....
	Totals	35	27	77.14
1 to 7 years, both inclusive.	Not vaccinated	96	53	55.2
	Vaccinated in infancy—good cicatrices	7	.....	.....
	" " " fair "	7	1	.....
	" " " poor "	8	2†	.....
	Post-vaccinal cases	22	3	.....
8 to 14 years, both inclusive.	Not vaccinated	71	27	38.
	Vaccinated in infancy—good cicatrices	36	2	5.55
	" " " fair "	11	.....	.....
	" " " poor "	37	6	16.21
	Post-vaccinal cases	84	8	9.52

* Recovered from varioloid, and subsequently died from convulsions.

† Cicatrices *very* poor—doubtful if successfully vaccinated.

TABLE.

Showing the protection conferred by vaccination up to the age of puberty, as compared with the protection subsequent to that period.

		Admit'd	Died.	Per ct.of deaths.
Under 14 years of age.	Not vaccinated	197	105	53.29
	Vaccinated in infancy—good cicatrices.	44	2	4.54
	" " " fair "	22	3	13.63
	" " " poor "	45	8	17.77
	Post-vaccinal cases	111	13	11.71
Above 14 years of age.	Not vaccinated	500	344	68.8
	Vaccinated in infancy—good cicatrices.	667	71	10.64
	" " " fair "	314	45	14.33
	" " " poor "	537	147	27.37
	Post-vaccinal cases	1,518	263	17.32

As the author remarks, these figures "clearly demonstrate that vaccination performed in infancy diminishes in protective power as the person advances in life, and especially after the age of puberty."

In considering the foregoing testimony, there is but one conclusion at which to arrive when considering the utility and desirableness of revaccination. There is no doubt but that the protective power does die out in the individual, and that there is a time in post-vaccinal life when an attack of the variolous disease may be so severe as to be scarcely, if at all, modified by the primary vaccination. It is also clearly demonstrated that the further removed the attack may be from the time of vaccination, the more severe will it be in character. The figures presented show that in all cases where a number of individuals have been revaccinated at one time, as in the army, there are many who "take" the vaccination apparently as well as if it were the primary operation, thus showing such persons to be really unprotected. The adoption of revaccination is therefore to be recommended most fully as a preventive measure against small-pox.

The time at which revaccination should take place can not as fully or clearly be determined, for reasons given in the preceding pages. It is better to err, however, in making the periods between vaccinations too short than too long; nor yet is it best to endeavor to enforce any useless inconvenience upon the public. The age of puberty is considered by many as the time of all others when the revaccination should be performed. There does not appear any especial reason why this should be a time chosen, in preference to any other, unless it be that fourteen years (that being the age considered as the time of puberty) is as long a period as should possibly intervene between the two operations. The five years of Prof. Flint appear needlessly short, as the published statistics show that the severity of a variolous attack, occurring so near the time of a perfect vaccination, is a trivial affair, and the mortality almost nothing.

There are some cases which present themselves for revaccination a few years after the primary operation, in which the protective power has so completely died out as to allow of a successful reinoculation. These cases are, however, so exceptional that it would be folly to take them as examples to prove that every four or five years the revaccination should be performed. Indeed, it is not often possible to obtain satisfactory results from the second introduction of the virus until much longer time has elapsed between the two operations. In

most cases a revaccination performed about the tenth year of life guaranties protection as perfect as though there had been an intermediate vaccination at five or eight years of age. It does not appear that it is best to wait until the indefinite time of puberty before insisting upon the operation, for it is found by consulting statistics that there is a marked susceptibility after passing the first ten or twelve years of life. It would be perhaps advisable to again revaccinate at the age of twenty, after which time it is doubtful whether there is any necessity for again introducing the vaccine matter into the system. By this mode of procedure, it is believed, all is gained that is expected from the operation of vaccination, without so annoying the public as to bring the measure into disfavor; of course it is always necessary to be satisfied that the primary vaccination was successful, the fact being demonstrated by the character of the cicatrices existing upon the arm of the individual. If such proof is not satisfactory, revaccination should be performed immediately upon inspection. It would be best to except from this rule of procedure those persons residing in a locality where an epidemic of small-pox was raging. In such cases it would be proper to immediately revaccinate *all persons*, irrespective of well formed cicatrices or statements made as to the time or character of the primary operation.

There are many persons who, no doubt, consider themselves secure from all danger from the contagion of small-pox by reason of a vaccination performed at a previous time, who carry with them no proof, in a well marked cicatrix, that such a vaccination was successful. There is a recollection, perhaps, of an inflammation following the introduction of the virus, but further than that nothing is known as to whether the whole system was brought under the influence of the disease. In too many cases the result of the operation is only known, from the lips of others by the attending physician himself, as after having once introduced the virus into the arm, no attention is given to the development of the disease, or of personally observing the attending phenomena. There is, therefore, no doubt but that the method by which the operation is performed, and carelessness in the seemingly minor details connected therewith, are fruitful sources of insufficient protective power.

There are many points of interest and value that may be discussed when considering the performance of the operation, and it is certain that by fully understanding them, and conscientiously endeavoring to carry them into practice, the physician may be able to guarantee a greater degree of protection, than if the operation is carelessly and to some extent ignorantly performed.

In endeavoring to fully consider this portion of the subject, the following divisions of the question will be made, so that it may be carefully studied in detail.

1st. The age at which vaccination should be performed.

2d. The selection of virus.

3rd. Methods of introducing the vaccine matter into the system.

4th. Number of vesicles desirable.

5th. Signs of successful and unsuccessful vaccination.

1st. *The age at which vaccination should be performed.*

Authorities pretty generally agree that the infant should be vaccinated during the first year of life. In a country practice, when there is no danger that the child will be exposed to the variolous influence, as strict an observance of this rule is not so imperative as in cities where there is a liability to exposure in so many different directions; public hacks, railway cars, assemblies of people and other city associations are fruitful modes of conveyance of the contagious miasm. It is, therefore, considered advisable, in city practice, to vaccinate when the child is three or four months old, provided always that the infant is free from any constitutional disorder. The organs of nutrition should be in such a healthy condition that the vitality may be fully sustained, provided any unpleasant complications should arise during the course of the vaccine disease. An exception should be made to this rule when small-pox is prevailing as an epidemic in any locality; in such case no age should be considered as too young, Even when the operation has been performed as early as the day of birth no serious results have been noticed; it is considered far wiser to risk an attack of vaccina at this early age, than to endanger life with an almost certainly fatal attack of small-pox.

In the instructions issued by the Lords of Privy Council in England, the following occurs: "Except so far as any immediate danger of small-pox may require, vaccinate only subjects who are in good health. As regards infants, ascertain that there is not any febrile state, nor any irritation of the bowels, nor any unhealthy state of the skin, especially no chafing, or eczema behind the ears, or the groin, or elsewhere in the folds of the skin. Do not, except of necessity, vaccinate in cases where there has been recent exposure to the infection of measles or scarlatina, nor when any erysipelas is prevailing in or about the place of residence."

The Edinburgh Medical Journal of November, 1871, speaking of an epidemic of small-pox then prevailing, remarks that, "There can be no doubt that the present epidemic has had the effect of causing several disputed points to be finally set at rest, and, among these, the question as to whether it was right to vaccinate women who were pregnant. The old idea was that vaccine, being a poison similar to that of small-pox, would cause abortion to take place, but this has been contradicted by all the first-class obstetricians. Next it was thought unsafe to vaccinate children much under six weeks, whereas the medical officers of the Privy Council has distinctly advised that children who are exposed to the influence of small-pox poison, should be vaccinated within a week of their birth. It was also supposed to be dangerous to revaccinate elderly people, but this has been shown to be incorrect. There can be no question that grown up people suffer, generally speaking, more from vaccination than children, the same as they do when attacked with measles, whooping cough, etc., and this, I believe has given rise to the idea of vaccination affecting people worse during what is termed a varioloid condition of the atmosphere."

2d. *The selection of Virus.*

There is at the present time a discussion in progress as to the advisability of employing bovine or humanized virus in performing vaccination. The testimony given by various writers is so conflicting that it is difficult to arrive at any satisfactory conclusions from a consideration of the subject as given by them. Those who have had much experience with the animal virus are much pleased with the results therewith obtained, and there are many reasons why it should be preferred rather than the humanized matter. As briefly as possible the views of the most prominent experimenters will be given, and although conflicting with each other on many points, it is certainly shown that there are reasons why discretion should be used in the selection of the form of virus to be employed in the performance of the operation in any given case.

Most authorities agree that virus taken from the cow direct produces a more marked result than humanized virus; that is to say all the local and constitutional symptoms are greatly aggravated. As a rule they concur in the opinion that it is more difficult to obtain the specific result when one animal is inoculated from an animal of another species. This fact has confused the minds of many, and given rise to the belief that

the disease as it appears in different animals is not the same.

It was some time after the appearance of cow-pox in man, before it was possible to convey the disease back to the cow from the human vesicle. This characteristic is noticed at the present day; many practitioners who employ the bovine virus are annoyed that no satisfactory result follows unless the operation is repeated several times.

From a series of careful experiments and observations, Dr. Benjamin Lee arrives at the following conclusions:—

1st. "That virgin vaccine lymph direct from the heifer is not easily absorbed into the human system, and that therefore it is not advisable to attempt its general use in the face of an epidemic or the presence of direct contagion.

2d. "That it is less readily absorbed in the case of infants than of older children and adults.

3d. "That, when absorbed, it produces the vaccine disease, in both its local and constitutional manifestations, in its most normal and perfect type, without unusual severity or complication.

4th. "That virus produced by inoculation of a single human being with virgin lymph, for the first time, is absorbed into the human system with excessive readiness, constituting the most active virus that can be procured.

5th. "That such virus is more likely to induce true vaccine in persons already vaccinated than ordinary humanized virus of long descent.

6th. "That what is true of lymph of the first remove is also immeasurably true of that of several subsequent removes, but to what extent, these experiments do not determine.

7th. "That, excepting the foregoing conclusions, it is a matter of primary importance that every large centre of population should be provided with the means for frequent revivifying its supply of virus by a return to the original source." (*New York Medical Journal, May*, 1873.)

Prof. Flint considers that while the effect produced by the production of animal virus is greater both locally and generally, still he does not think that the protective influence is any more perfect on account of such excessive inflammatory action.

The deduction made by Prof. Aitken in a comparison of the effects produced by the use of either form of virus, correspond substantially with those of Dr. Lee. On page 402 of the first volume of his work on the Science and Practice of Medicine, he says: "There seems to have been great uncertainty and difficulty often attending the actual attempts to transfer the

specific virus of these eruptive or variolous diseases from one animal to another. Second.—These experiments show the marked improvement which sometimes takes place in the energy, and therefore in the quality of the specific virus, by subsequent removes or inoculations, in animals of the same kind, after the virus had been successfully implanted in one of them. This energy and improved quality was shown in the more perfect development of vesicles, and in the more active manifestations of the primary symptoms. The subsequent inoculations of such improved lymph seem to produce less severe and less dangerous local results, the virus seems less acrid, less virulent, and less mischievous, having apparently acquired increased specific activity combined with mildness of action, and a greater susceptibility of transmissions from one animal to another of the same kind.

"During the siege of Paris, Dr. Quinquand had all succesful cases with the human lymph, but only one-third with that from heifers. Dr. Thevenot, with calf vaccine, had only two successful cases out of twenty-one. Of thirty-two surgeons in Paris who sent in their reports, one says that vaccine from the calf became better after passing through the systems of three or four different children, though bad and difficult to introduce for the first time. The rest (thirty-one) agree that vaccination from the calf was provokingly unsuccessful, succeeding, at the very utmost, only in a fourth of the children vaccinated directly, and much less from calf virus or glasses. Of sixteen others who who tried the calf virus, thirteen failed completely. Dr. Gaillard, who succeeded 170 times out of 283 with calf vaccine, was successful in 2,740 times out of 2,856 with Jennerian vaccine."—[*Edinburgh Medical Journal*, *November*, 1871].

Notwithstanding, many practitioners, from experience, believe that the use of animal virus is not as satisfactory as that taken from the human subject, for the reasons given in the foregoing quotations. Still, there are several recognized advantages derived from the employment of the matter taken directly from the cow, not the least of which is the growing prejudice of the public in favor of the animal virus, and the request, frequently made, that the attending physician shall employ that form in performing the operation. There are, however, at the present time many physicians who have made a specialty of the performance of the operation of vaccination, who very strongly urge the adoption of the animal virus as far preferable to the other form; and their testimony, certainly, to a great extent, refutes the statements already made.

Prominent among those who have given particular attention to the subject is Dr. Frank P. Foster, Director of the Vaccine Department of the New York Dispensary. The reports made by him to the Board of Trustees of that Institution are worthy of careful consideration, for the reason that his experience has been, perhaps, as great as any one who has employed the animal virus. The vaccine used by him originated in the spontaneous cases of cow-pox, discovered at Beaugency, France, in the year 1866, and has never passed through the human system. In his hands the animal virus imparted the vaccine disease to the human subject as readily as did the humanized virus.

There is no doubt but that, during the few years just past, the employment of animal virus has become much more popular with the profession than in former years; one reason may be the demand for its employment by the public, and another, quite as probable, the readiness with which the market can be supplied with fresh reliable vaccine, from the many institutions which have been paying particular attention to its production. The enormous demand may be appreciated by noticing that during the year 1873, the New York Dispensary alone supplied 70,302 quill slips, sending them to all portions of the globe.

From Dr. Foster's report for the year 1871, the following extracts are taken, and they certainly show that he has not experienced the same difficulties in the employment of animal matter, as have those whose testimony has heretofore been given:

"The following statement shows the results, as regards success, which have been obtained at the dispensary with bovine and humanized virus, respectively;

Per centage of success in primary vaccinations with the long humanized lymph, in use in 1870	78
Per centage of success in primary vaccinations with humanized lymph of early removes, in use in 1871	9[illegible]
Per centage of success in primary vaccinations with bovine lymph, in use in 1871	9[illegible]

"The number of cases (2,983) furnishing the results upon which this estimate is founded, is certainly large enough warrant our forming a decided opinion upon one of the chief objections urged by the opponents of animal vaccination, namely, that the successful vaccination of children with bovine virus is a matter of considerable difficulty; and the only deduction that we can draw from the facts, as we have observed them, is that *this objection is entirely unfounded.*"

In the returns for the year 1873, Dr. O'Brien reports 4,322 primary vaccinations, *without a single failure*; this is certainly a remarkable result, and the animal virus being employed exclusively, the fact certainly tends to disprove the statement that with its employment a great difficulty is experienced in implanting the disease.

In respect to the high degree of inflammatory action, generally considered as a result of the introduction of animal virus, Dr. Foster says: "Another great objection urged against animal vaccination is that vaccination of the human subject with bovine virus is apt to produce dangerous severe inflammation. Our experience certainly has not shown any foundation for this fear. Our work is for the most part among an ignorant class of people, who are very much given to using meddlesome treatment of their own for the vaccinal efflorescence, thereby certainly favoring the occurrence of bad results; and who look upon a very sore arm as a reason more potent than any other for submitting a child for inspection. Such being the case, if any example of dangerous inflammation had occured in our practice, we should certainly have been made aware of the fact. So far from this having been the case, it has been a matter of common remark at the Dispensary that there were fewer inflamed arms seen during the past year than is usually the case. Not a single case of very severe inflammation has occurred; but the few that have made any approach to it were in cases in which the humanized lymph had been used. Whether or not this fact is to be explained by supposing that bovine virus actually produces less inflammation than does the humanized, I am not prepared to say. I think it not unreasonable to conclude that this freedom from inflammatory complications has been due to our having, more invarably than ever before, adhered to the use of lymph in preference to the crust; and to the enforcement of great carefulness in the performance of the operation."

Dr. Foster says further: "It seems evident to me, then, that the practice of animal vaccination has positive advantages, and that we may consider the following proposition as well established:

1. "Vaccination with bovine virus is at least as successful as that with humanized virus.

2. "There does not appear any valid reason for looking upon vaccination with lymph procured from a succession of bovine inoculations, as inferior, in the protection conferred against small-pox, to those with humanized virus, or with virus direct from cases of spontaneous cow-pox. On the con-

trary, in the case of the inoculated bovine disease, we can always be sure as to the precise period of the disease; and consequently, in taking the lymph, can choose the time when it is more energetic. Whereas we can never or seldom assign a precise date to the origin of a spontaneous case; and indeed must very rarely have an opportunity of seeing such a case until the proper time for taking lymph has passed.

3. "Vaccination with bovine virus certainly does not entail a risk of any greater degree of inflammation than is generally met with in the use of the humanized stock.

4. "Animal vaccination enables a careful vaccinator to be *positively certain* that he runs no risk of unwittingly conveying syphilis or other taints in vaccination.

5. "The amount of vaccinal efflorescence considered necessary to constitute an effectual prophylactic against small pox is, with bovine virus, attainable with a decidedly decreased amount of traumatism.

6. "As is now generally admitted, animal vaccination is a great addition to our scources of vaccine; and furnishes a safe-guard against 'vaccine panics.' On this account alone, if on no other, it should be steadily maintained."

In referring to the testimony given by the several witnesses quoted, it is difficult to arrive at satisfactory conclusions. The report of Dr. Foster contradicts the experience of many worthy observers; not only those who experimented some years ago, but those also whose investigations have been made as recently as his. The statement made by him in relation to the severity of the inflammatory action cannot be regarded as at all conclusive. His evidence appears as of a negative character, rather than a positive demonstration of facts; for he asserts that in Dispensary practice it is impossible to follow the course of the vaccine disease, and therefore he takes it for granted that unless the case returns for treatment, there has been no unusual inflammatory condition.

There is positive advantage in being able to quiet satisfactorily any popular prejudice as regards syphilitic inoculation; many persons believing that there is a great risk in the employment of humanized virus; this does not exist when animal virus is used. Whether such danger is a reality will not now be discussed; but when considering this portion of the subject, it is hoped that facts can be produced to demonstrate that by a careful selection of pure humanized virus, this prejudice can be to a great extent removed.

The establishment of institutions from whence a supply of animal virus can at all times be obtained, is certainly a point

of not a little moment; for there can in such case be no danger that the demand can ever excede the supply, and thereby create a panic.

From the experience of the writer, in the employment to a considerable extent of both animal and humanized virus, and by a careful comparison of the investigators whose views have been presented in this article, as well as many others, the following conclusions are arrived at; believing, however, that very little choice remains between the two forms of virus.

1. It is clearly demonstrated that in the lymph taken from either a human or bovine vesicle, is found all that is necessary to produce the vaccinal disease in the human subject, and so protect the system against small-pox.

2. In most cases the constitutional and local manifestations are generally more severe after the employment of animal than human virus; but there are exceptional cases where the latter form of vaccine matter creates a much lighter grade of inflammatory action.

3. There is no marked difference in the ability to *readily* impart the vaccine disease in the employment of either animal or human virus.

4. As there is a prejudice amongst the people as regards the implanting of syphilis, or other blood poisons, into the system, by the employment of humanized virus; when the use of animal virus will remove such prejudice, it should in all such cases be employed.

There are two forms in which the vaccine matter is presented for use, there being no difference, no matter what may be the source of supply. In one form, the lymph is withdrawn from the vesicle, and used immediately or preserved hermetically sealed in capillary tubes. The other form is where the lymph is dried upon quills or ivory points, previously inserted into the vesicle; or where it is allowed to dry *in situ*, forming a crust or scab, to be removed when entirely inspissated. The question here arises, whether there are reasons why one form should be employed in preference to the other.

In Germany and some other countries, arm to arm vaccination, as it is called, is preferred, for the reason that lymph taken from one patient and introduced immediately into the system of another, does not run the risk of deterioration from the action of the atmosphere. This is, perhaps, the most certain mode of procedure; but it is only possible to employ it under the most stringent regulations; such that render it out of the question to generally practice the method in this

country. In private practice it is very difficult for the physician to bring two patients together at just the right time; one who has been vaccinated and the other who desires so to be. In armies and hospitals it might be possible; but it is certainly impracticable in general practice.

As has been mentioned it is possible, to withdraw the lymph from the vesicle and preserve it for a time unchanged. It is found in the market either dried upon points or sealed in tubes. If required for immediate use, the slips or points are as reliable as any other form; but when wanted for future service the tube should always be selected, as being preserved from the action of the atmosphere; the specific power of the virus is not destroyed. Great care should be exercised that the lymph be taken from none but typical vesicles, and only when the virus is most active. It is considered best either on the sixth, seventh, or eighth day after the performance of the operation. Lymph should be clear, and the vesicle from which it is taken firm, translucent and pearl colored.

The instructions given by the Lords of the Privy Council, London, being the result of the experience of the most prominent specialists, is worthy of careful attention, and the recommendations should be adopted in the selections of lymph. "Never take lymph from cases of revaccination; never use or furnish lymph which has the slightest admixture of blood; take lymph only from well characterized, uninjured vesicles, at the stage (the day week after vaccination) when they are fully formed and plump, but there is no perceptible commencement of areola; take lymph only which, as it issues from the vesicle, is perfectly clear and transparent, and none which is at all thin and watery. Never squeeze or drain any vesicle. From such a vesicle as vaccination by puncture commonly produces, do not, under ordinary circumstances, take more lymph than will suffice for the immediate vaccination of five subjects, or for charging seven ivory points, or filling three capillary tubes; and from larger or smaller vesicles take only in proportion to their size. Be careful never to transfer blood from the subject you vaccinate to the subject from whom you take the lymph. Note any case wherein the vaccine vesicle is unduly hastened or otherwise irregular in its development, and if similar results occur in other cases vaccinated with the same lymph, desist at once from employing it. Change the lymph if, on the day week after vaccination, the vesicles are not entirely free from areola. Keep the lancets, and other instruments used, scrupulously clean, and do not use them for other surgical operations. Clean the instruments used thoroughly after one operation before proceeding to another."

The vaccine crust is, perhaps, more generally employed by the profession in private practice than the lymph, not only because it is more readily obtained, but because it is less troublesome to carry from place to place. There is no reason why, with proper care, as good results may not be obtained from this form as any other.

In selecting a crust attention should be given to its appearance, as the whole energy of the contained virus may have been lost in the keeping. A crust should be of a dark brown lustrous color, round or oval in form, with a more or less umbilicated center; those which are hard and crisp to the feel are more reliable than those which are soft, and bend, rather than break, upon pressure.

The crust may be preserved for some length of time by carefully excluding from the action of the atmosphere. The method which is generally adopted is the enveloping of the crust in beeswax and tinfoil, immediately upon removal from the patient. During the last month the writer has successfully vaccinated several infants with a crust thus preserved nine months previously. Dr. Collins, in a number of the Boston Medical and Surgical Journal, 1858, publishes the results of experiments made with glycerine as a preservative agent. The scab, being pulverized upon a glass plate, is dissolved in pure glycerine, and then drawn by suction into capillary tubes, and hermetically sealed. He states that he was able to fill fifty tubes from one crust, and therefore be enabled to have a constant supply of vaccine, the activity being unimpaired, as proven by experiment many months thereafter.

Müller demonstrated that by mixing glycerine with lymph, the activity is not at all diminished, and the disease developed from the introduction of such virus is as complete as if the glycerine were not present. Curschmann, in Ziemssens Cyclopædia, says on this subject. "I have never seen better developed vaccine pustules than at the Berlin Vaccine Institution, where such lymph is employed: and after my own numerous experiments I can assert that the certainty of result is not at all less than after the use of the pure lymph. Müller usually mixes the lymph carefully with two parts of glycerine and two parts of distilled water (by means of a small brush in a watch-glass), and preserves the liquid in air-tight capillary tubes. This mixture, according to M., can be still further diluted (one part to eight), without suffering any perceptible loss of its efficacy. Beyond this its activity is lessened in proportion to the degree of its dilution. Reiter obtained a feeble action

with dilutions consisting of one part of lymph to two hundred of distilled water, and he ascertained that, as a rule, in order to obtain any effect, a greater quantity must be employed the more the virus is diluted."

As has already been shown by the instructions to the Privy Council, no matter what form of virus is used, too much care can not be employed in selecting the subject, as well as the vesicle from which to obtain the supply. The virus from infants is always to be preferred rather than that taken from adults, and in no case should the result of revaccination be employed, no matter how near typical the vesicle may appear. Note well also the general health of the person from whom the vaccine is taken, so that, if any unpleasant results follow its employment, assurance can be given that such do not proceed from negligence in this direction.

The spurious or imperfect results of vaccination are dependent to a greater extent than any other upon the care taken in the selection of the virus. In 1867 the United States Sanitary Commission published a paper by Dr. Elisha Harris, giving the causes and results of spurious vaccinations, in both the United States and Confederate armies. As it is valuable in impressing the facts under consideration, a portion is reproduced here.

"(1). There were three kinds of spurious vaccination prevalent in the American Armies: (*a*) that which occurred in consequence of the loss of the specific property in the once good lymph or crust used; (*b*) that which resulted from the impairment or destruction of the vesicle as soon as it began to form, in the marching and excessive exercise of the soldier, and that resulting from the use of the sero-purulent matter of such destroyed vesicle in vaccinating other persons; (*c*) that resulting from the employment of matter from pustules or crusts that never had the genuine qualities of vaccine virus.

"(2). Scurvy and all asthenic dyscrasias of army life, not only prevented or greatly impaired the normal operation and effect of genuine vaccination, when soldiers with such conditions were subjected to vaccination, but they frequently became the causes of certain morbid phenomena, as obstinate ulcers, &c., which caused the greater part of the evils from vaccination during the war.

"(3). In the armies, it was never proved that the normal vaccine vesicle communicated any other than normal innocuous virus: but from carelessness in taking lymph at its perfection, and by neglecting to observe the rule, never to use lymph or crusts not perfect in all respects, and free from blood

or pus, frequent instances of inoculation with purulent matter or unhealthy blood happened.

"(4). By the use of matter, fluid or concrete (purulent or morbid in either case), taken from sores of any specific and enthetic character. As (*a*), erysipelatous and ecthymatous: (*b*), that of zymotic ulceration and destruction of tissues, and possessing the properties of a morbid poison: (*c*) syphilis, primary or secondary, whether communicated by a lancet, or contaminated vaccine points or crusts: or, as occasiona,lly happened, the manifestation of syphilitic phenomena in connection with or supervening upon genuine or spurions vaccination.

"(5). The deterioration of genuine virus, by transmission through scorbutic and unhealthy persons, or when at the time of revaccination the protective power of a former vaccination was partly retained, or to the continued use of virus from adult soldiers, many of whom were suffering from unhealthy influences, instead of using lymph from the primary vesicles of healthy infants.

"(6). The destruction or deterioration of originally good virus by heat and humidity.

"These results substantiated the observation of Jenner as to the necessity of guarding against deterioration of the virus of cow-pox, which, losing its spccific property, ceases to be prophylic, army experience would go to prove that genuine vaccination is an absolute safeguard against small-pox."

3*d*. *Methods of introducing the vaccine matter into the system.*

It might seem reasonable that if the virus is introduced into the system by any method that would guarantee its absorption into the circulation, it would be all that could be desired on the part of the practitioner. To some extent this is the case, but there are reasons why attention should be given to the consideration of this portion of the subject, and that proper care should be enjoined upon those who perform the operation, so that it may be made certain upon their part that absorption has taken place. There is no doubt but that frequently a want of success in obtaining the desired result is charged to a loss of activity in the virus employed, when, in reality, carelessness in the manner of its introduction into the system, has far the most to do in causing the failure.

There are three methods, all of which have been employed to a greater or less extent, in the performance of the opera-

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tion. Either method is attended with success, and may be selected as the proper one, its selection depending entirely upon the preference of the practitioner. Perhaps scarification is more generally employed in this country than either of the other two, puncture or vesication, although in later years by the invention of a spring vaccinator the method of puncture has become quite popular.

In the act of scarification, a number of scratches are made at the point at which the vesicle is desired. It is best to be careful that these cuts or scratches do not penetrate to such an extent as to cause any considerable flow of blood, as it would be possible to wash away the virus from the absorbents. In many cases, however, even a comparatively large flow of blood does not prevent the absorption of a sufficient amount of the specific matter to cause the vaccine disease.

If quill or ivory slips are used, upon which the virus has been preserved, they should be slightly moistened and lightly rubbed over the scarified surface for a second or two. When tube lymph is employed, it should be blown out upon a clean glass, and conveyed to the arm upon the point of the lancet and applied in the same manner as described for the slips. In the employment of a crust or scab, a portion of its center (all the margins being carefully trimmed away) should be reduced to powder on the slip of glass, with the knife, moistened with water, and applied after the same manner as liquid lymph, being certain that a sufficient quantity is used to insure success. In no case should the dry crust, as has been advised by some, be pressed upon the denuded surface, and allowed to dissolve *in situ.*

When the virus is introduced by puncture, the lancet should be made to penetrate the cuticle in an oblique direction so as to make a slight puncture, reaching the true skin beneath; two or three punctures should be made for each intended vesicle. The lancet used should be charged with either lymph or the liquified crust as each puncture is made. Recently an instrument has been devised, similar in some respects to the spring lancet, by which a charged needle is pushed into the skin, thus facilitating the operation, and overcoming the fear of the knife, so frequently manifested, especially in children.

The third method spoken of was introduced by Mr. Ellis, of London. Having formed a small blister, the cuticle is raised and the virus placed beneath it. It does not seem that any advantage could be derived from such an operation, and the time, trouble, and discomfort, to both the practitioner and patient, would be considerably greater than if either of the other

methods were adopted. If protection from the rubbing of the clothing is the object, a piece of isinglass plaster applied over the point of introduction is all sufficient, and does not in the least interfere with the development of the vesicle. Even this procedure is not necessary, for if the arm is exposed to the air for a few minutes until dry, perfect absorption will be secured.

In this connection, it is well to mention that the selection of the location for the performance of the operation, should be regarded as a matter of some importance. Not that the virus will be more readily absorbed when introduced at one point of the surface than at any other, but because the physician will the more readily decide whether vaccination has been previously performed if the cicatrix is found where it is most frequently located, upon the arm. Prof. Flint takes the correct view when he says: "The situation for the introduction of the vaccine virus, should always be that usually selected, viz: on the arm near the insertion of the deltoid muscle. Uniformity in this respect enables physicians and others to ascertain, without delay or doubt, the fact of a previous vaccination, and to judge of its success by an examination of the cicatrices."

4th. Number of vesicles desirable.

In the instructions issued to the vaccinators in England, the the following occurs: "In all ordinary vaccinations, vaccinate by *four* or *five separate punctures*, so as to produce *four* or *five separate good-sized vesicles;* or if you vaccinate otherwise than by separate punctures, take special care to secure the production of *four* or *five separate good-sized vesicles.*"

Many writers, and among them Curschmann, perhaps the latest who has written upon the subject, advocates the introduction of virus at many points. According to the abovementioned author, "from four to six usually suffice for each arm;" others regard the system as thoroughly protected by one insertion as if many had been made; in fact, it is the rule in this country to vaccinate by only one or two, points of insertion.

In consulting statistics, it seems that a relation certainly exists between the number of cicatrices and the percentage of mortality in cases of small-pox occurring after vaccination. The following table, given by Mr. Simon, and showing the percentage of deaths occuring in nearly 6,000 cases of small-pox contracted after vaccination, arranged with reference to the number of cicatrices borne by each patient, is interesting in connection with this topic:

CASES OF SMALL-POX CLASSIFIED ACCORDING TO THE VACCINATION MARKS OR CICATRICES BORNE BY EACH PATIENT RESPECTIVELY.	NO. OF DEATHS PER. CENT. IN EACH CLASS RESPECTIVELY.
CLASS I. Stated to have been vaccinated, but having *no cicatrix*	21¾
CLASS II. Having one vaccine cicatrix	7½
CLASS III. Having two vaccine cicatrices	4⅛
CLASS IV. Having three vaccine cicatrices	1¾
CLASS V. Having four or more vaccine cicatrices	¾
Unvaccinated	35½

Prof. Aitken arranges all vaccinated persons into four separate classes, depending upon the number and character of the cicatrices, each class being more or less perfectly protected, as these marks of successful vaccination are found upon the person:

"Class I. Best protected, having more than two *typical* marks.

"Class II. Sufficiently well protected, having two *typical* marks.

"Class III. Moderately protected, having two or more *passable*, or one *typical* mark

"Class IV. Badly protected, having *bad* marks, or having only one *passable* mark."—[*Science and Practice of Medicine*, *Vol.* 1, *Page* 420.

The following is taken from a report made by Mr. Marson, and is based upon 15,000 cases.—[*Reynolds' System of Medicine*, *Vol.* 1, *Page* 499.

CLASSIFICATION OF PATIENTS WITH SMALL-POX.	NO. OF DEATHS EACH CLASS.
I. Unvaccinated	37.
II. Stated to have been vaccinated, no cicatrix	23.57
III. Vaccinated	.....
(*a*) Having one vaccine cicatrix	7.73
(*b*) Having two vaccine cicatrices	4.70
(*c*) Having three vaccine cicatrices	1.95
(*d*) Having four or more vaccine cicatrices	0.55
Having well-marked cicatrices	2.52
Having badly marked cicatrices	8 82
IV. Having previously had small-pox.	19.

Dr. Welch has published a table in his report for 1872, showing the same classification as the foregoing tables, with somewhat different result.

TABLE.

Showing 1,789 *cases of small-pox classified according to the number and quality of the vaccine cicatrices borne by each case.*

	Admitt'd.	Died.	Per ct. of Deaths.
Said to have been vaccinated in infancy—*no visible cicatrix*	140	79	56.42
Vac. in infancy—*one good* cicatrix	400	41	10.25
" " " *fair* "	222	36	16.21
" " " *poor* "	502	143	28.48
Total number showing *one* cicatrix.....	1,124	220	19.57
Vac. in infancy—*two good* cicatrices...	108	12	11.11
" " " *fair* " ...	36	3	8.33
" " " *poor* " ...	33	7	21.21
Total number showing *two* cicatrices...	177	22	12.42
Vac. in infancy—*three good* cicatrices.	64	7	10.93
" " " *fair* "	21	2	9.52
" " " *poor* "	26	7	26.92
Total number showing *three* cicatrices.	111	16	14.41
Vac. in infancy—*four or more good* cicatrices	145	13	8.96
Vac. in infancy—*four or more fair* cicatrices	52	5	9.61
Vac. in infancy—*four or more poor* cicatrices	40	5	12.5
Total number showing *four or more* cicatrices	237	23	9.7

In speaking of the various classifications of cicatrices, it will be noticed that they are called, typical, good, fair, passable, bad or poor. It is very important that a knowledge of the distinctive characteristics should be so understood, that the proper classification may be readily made, when any form of cicatrix is under observation. Within a very short time several writers have endeavored to show that a typical cicatrix may be formed after any ulceration as circumscribed in character as is the vaccine vesicle or pustule. This is certainly a mistaken idea, as the vaccine cicatrix when typical of a perfect vaccination can be rarely mistaken for anything else.

Prof. Aitken has fully designated the distinctive appearances of the various forms of cicatrices mentioned in all

classifications, and that they may be thoroughly understood, they are here transcribed: "(1) Typical, excellent, perfect, good or first-rate cicatrices are recognized by their circular form, and pale or white appearance. They are somewhat depressed and dotted, indented or foviolated with minute pits or depressions over the base, supposed to indicate the number of compartments in the anatomical structure of the vesicle. In some instances there are radiations from the center. It has been considered that the normal diameter of a cicatrix produced by a single insertion, is one third of an inch; that scars of larger measurement are generally of double or multiple origin.

"(2) 'Fair,' 'passable,' or 'modified,' cicatrices possess the characters of the typical cicatrix, but they are less perfectly expressed, the contour being less regular, and the size just within the average above mentioned. To irregularity of contour, however, it must be remembered that scars resulting from single insertions (as in the ordinary method of puncture), are notably uniform, so that irregularity of contour, when associated with a single puncture for vaccination, indicates that the progress of the vesicle has been irregular; but when the scar results from several contiguous insertions or scratches, no such inference can be made.

"(3) 'Bad cicatrices,' which must be held denoting 'failures,' are such scars as can not be recognized as the product of vaccination, by any circumstance beyond being found near the usual site of the operation. Scars also having a less diameter than *a quarter of an inch* ought to find a place amongst this class; and, generally, all ill-defined, faint, scarcely discernible white patches, especially such as consist of large, flat, ill-defined shiny marks. Fruitless attempts at vaccination may be also recognized by the permanent traces left of the parallel, or transverse, scratches employed at the operation." [*Science and Practice of Medicine, Vol. I., p.* 418.

While it is observed by the tables published herewith, that there does exist a relation between the number of the points of insertion and the degree of protection conferred by the operation, still there remains a question whether this increased degree of protection is not obtained at too great a cost in the amount of traumatism observed when as many as from four to six pustules have been produced, as recommended, upon both arms. There is no doubt that the system of the infant is as trully infected by cow-pox disease, by the absorption of the virus at one point of insertion, as though many punctures were made. And certainly the danger of attending traumatic

fever is lessened to a great degree. In the daily practice of most physicians in this country there is an antipathy to the multiple mode of procedure, and in many cases it is doubtful whether the consent of parents would be willingly given to the performance of as diffusive an operation as has been mentioned. If such were positively necessary, of course it should in all cases be insisted upon, but it is proven that almost positive protection is given the infant by the formation of one or two pustules, and it is recommended that that number of insertions, and no more, be made in the performance of primary vaccination of infants.

If revaccinations are insisted upon at the times, as stated in the first pages of this monograph, there is no doubt that as perfect protection will be guaranteed through life, as though the advice of the older, and especially the German writers, was explicitly followed.

5th. Signs of successful and unsuccessful vaccination.

Having introduced the virus into the arm, the busy practitioner frequently gives no more attention to the case, relying entirely upon the testimony of those interested as to whether the operation proves a success or otherwise, and frequently takes it for granted that the desired result has been produced if the patient is not presented for a repetition of the procedure. This should not be so. No one is capable of judging as to whether the local or general manifestations are sufficiently distinctive as to warrant the conclusion that the disease is following the usual course of genuine cow-pox, unless thoroughly conversant with the typical form of the disease.

In order that protection may be guranteed with any degree of certainty, attention should be given by the physician to the development of the vesicle, with its accompanying phenomena, and the fact demonstrated beyond question that the disease under observation is the genuine, and not the so-called spurious form of vaccinia.

In successful vaccinations no effect is noticed until the last of the second or beginning of the third day after the introduction of the virus. At this time a small hardened point or elevation appears at the site where the puncture was made. A faintly defined ring of a pink or redish color is also noticed surrounding these elevations. This redness gradually increases until, at the end of the fifth day, the cuticle is elevated and orms a distinct vesicle of a whitish color. This vesicle is

filled with a clear, thin liquid, called lymph. The day following being the sixth, the vesicle becomes umbilicated, having raised edges and a depressed center; local inflammation becomes manifest in a bright ring or areola surrounding the vesicle. All these phenomena increase until the eighth day, when the vesicle is fully developed, at this time having a pearly, white appearance; sometimes however, being, if mixed with pus, of a yellowish color. In size, the vesicle varies from $\frac{1}{4}$ to $\frac{1}{3}$ of an inch in diameter, and projects considerably above the general surface; on the ninth or tenth day the areola has increased in size and intensity of color, until the circle of inflammation extends an inch or more around the vesicle; sometimes a number of vesicles are found springing from the inflammatory ring, accompanying this angry appearance, the whole sub-cutaneous tissue becomes more or less indurated and painful to the touch, the arm being at the same time enlarged and tumefied. By the tenth day, all the symptoms denoting febrile action are at their height; at this time the neighboring lymphatics frequently become indurated, and it is not unusual to find streakings of red extending toward the shoulder and elbow. On the eleventh day the inflammation usually begins to subside, and two or three concentric rings of redness make their appearance at various distances around the vesicle, swelling and tenderness begin to subside, the vesicle becomes dry and brown, and by the fifteenth day a crust or scab is formed, which, unless removed, will continue to desiccate and completely dry up and fall from the arm on the twenty-first day. Beneath this scab the skin is first observed of a red color and tender to the touch, but gradually whitens, and remains through life the cicatrix which is taken as the exponent in after life of the successfulness of the vaccination.

The foregoing is descriptive of a typical case of successful vaccination, and a patient who has manifested all these phenomena may be considered safe, for a time at least, from the small-pox contagion. The grade of inflammatory action is not in all cases as severe as has been shown in the foregoing description, but in all cases when the protection is considered perfect there should not be any considerable deviation from the manifestations here presented. The first appearance of the vesicle may sometimes be delayed longer than the third day, but after it does begin to form the course of the disease should be as has been described.

If there are any marked alterations from this mode of progression, the name spurious or false cow-pox has been given to the disease so developed. This name is not proper if it is

intended to convey the impression that there is another form of disease which resembles cow-pox but is not the true disease. There is no doubt that there are times when the human system will not receive the vaccine poison in a manner that will allow of proper development of the disease, the vesicle simply aborting without creating any constitutional disturbance—this lack of development not depending in the least upon the quality or character of the virus introduced, but entirely upon the general condition of the patient. It does not follow however, that if such a person was exposed to small-pox contagion, that disease would not be as readily contracted as though the attempt had never been made to perform vaccination. The experience of all physicians goes to show that in some cases the vaccine virus must be inserted many times before the desired result is obtained.

It is a most important matter with the physician to understand the differences between true and this so-called false vaccine disease, for in one case protection from small-pox may be insured and in the other there can be no such immunity promised. As the phenomena accompanying the true disease have been fully described, it is not out of place to present the following description of false cow-pox as given by M. Bousquet, in order that a comparison may be instituted between the two:

"True cow-pox hardly begins to show itself at the end of the third day, but the false is much earlier, and may be seen from the first to the second day after introduction of the virus, a circumstance which from the first constitutes a distinction between the two affections. But this precocity is not by itself sufficient to establish a differential diagnosis. False cow-pox is sometimes so rapid in its course as only to appear that it may disappear; at other times it shows itself in the form of a small pimple, more appreciable by the eye than by the sense of touch. This pimple goes on increasing in size till the fourth or fifth day, leaving the physician uncertain as to its future progress, but on the sixth or seventh day, in place of becoming developed, its progress is arrested it grows pale and dries up. At other times, it advances farther, always preserving in its rapid development a conical and globular shape, which I look upon as an unerring a sign of false cow-pox, as the flattening and central depression of the pock are signs specifically characteristic of the true.

"The false pock is sometimes red and sometimes yellowish. It never assumes the brilliant silvery lustre which distinguishes the prophylactic cow-pock. Though not exactly irregular in

shape, it has an ill-defined margin. Some time between the fourth and seventh day—for the false cow-pox has nothing fixed or normal in its course—it becomes yellow, suppurates and dries up."—[*Trousseau's Clinical Medicine, Vol. II, p.* 137.

To this description Trosseau adds: "That false cow-pox is often accompanied, as local symptoms, by inflammatory indurations of the subjacent cellular tissue, disagreeable itching in the affected parts, swelling and pain in the axillary glands; and as general symptoms, by restlessness, headache, and sometimes by fever. There is another kind of false, or, to speak more correctly, of aborted cow-pox. It is met with when the pustules of true cow-pox have their development arrested or impeded by excoriations caused by the scratching of the infant, by the pressure of too tight clothes, or by the irritation of unnecessary handling. Under such circumstances the suppuration begins at once, the pustule become, yellow, swells, and its virulent lymph disappears."

When a vaccination is performed, it frequently happens, especially if a long time has elapsed since the primary operation, that the vesicle found presents all the characteristics of a typical vaccination; generally, however, its appearance is more or less modified by the preceding vaccination. In many cases after the introduction of the virus, the arm almost immediately takes on an angry look, the color being greatly heightened, and the swelling and œdema extensive. Such a condition may exist for two or three days, after which it will subside entirely, leaving no scab more than might be formed by the scarification alone. At other times a papule may be noticed with no appearance of a vesicle, the inflammation progressing for four or five days and then rapidly declining. As a rule, the areolar tissue becomes involved to a greater degree in cases of secondary vaccinations, and the febrile disturbances may also be considerable.

In some cases of primary vaccination, it is difficult to determine satisfactorily whether the disease has developed only locally, or has brought the whole system under its influence. During Jenner's time this question was discussed, and Mr. Bryce succeeded in establishing a procedure, whereby, in every case, perfect immunity could be promised after the performance of vaccination. Not relying at all upon the appearance of the vesicle, by reinoculation upon the other arm he became certain that the virus had produced the desired constitutional results, and, therefore had been successfully performed.

A description is here given in the words of the originator of "Bryce's Test," and no doubt if the suggestions therein were

more frequently carried out, far less unsuccessful vaccinations would be recorded, "For some time," he says, "after the introduction of the cow-pox inoculation into medical practice, many cases were related in which an eruption of pustules, more or less numerous, was said to take place, similar to what happens in small-pox. While these reports were propagated, and certified to by men who seemed worthy of credit, even although no instance of the kind had come under my own observation, I entertained hopes of so conducting the new inoculation, in every case, as to obtain a certain and well-defined mark of a constitutional affection; for if any eruption of pustules belonged to cow-pox in any case, as a consequence of the peculiar fever or constitutional ailment thereby induced, I thought that one or two pustules might be made to appear in every case. It is well-known that by irritating any part of the skin, by the application of heat, of a stimulating plaster, or various other substances, we can produce a greater number of pustules in small-pox upon that particular part than would have otherwise appeared; and, judging from analogy, I expected that the same thing might have been effected in cow-pox. Such trials I have made; and, although they were conducted with as much anxiety and care to produce pustules as other persons seem to have taken to avoid producing them, yet they have constantly failed. Nay, these trials have now been made under such a variety of circumstances without effect, as to confirm me in the opinion that an eruption of pustules, as a consequence of constitutional affection, does not belong to small-pox.

"Foiled in my attempts to so conduct the inoculation of cow-pox as to produce pustules, I recollected some experiments which had been made with regard to the inoculation of small-pox. It was found, that if the same person was inoculated every day until the fever induced by the first inoculation supervened, all the other punctures quickly advanced in their progress; and that, in the course of a day from the time the fever or general affection began, even that puncture which had been last made, perhaps only twenty-four hours before, equalled in maturity the first one made, perhaps eight or nine days before, and from which the fever had arisen.

"In this case, it appears to me evident, and, I think, must be admitted by every person, that even had no other pustules appeared on the body than those occasioned by the repeated inoculations, nay, had there even been no fever observed in consequence of the inoculation, yet as the pustule occasioned by the last puncture had been suddenly accelerated in its pro-

gress to maturation, at the time the general or constitutional affection should have appeared, this alone was a sufficient proof of the presence of the variolous action in the system.

"Judging again from analogy, I expected that the same thing, which thus happened in the small-pox inoculation, might also take place in that for the cow-pox; and the unexpected appearance of one or two vesicles upon children that I had inoculated, which vesicles were quite characteristic of the ailment, and the appearance of which I could only account for from a second and accidental inoculation during the course of the disease (as mentioned in page 101), strengthened my hopes. And certainly, if we find in cow-pox, where the inflamed and hard areola does not take place, at least in the regular course of that affection, until the end of the seventh or begining of the eighth day from inoculation, that a second inoculation, performed for example at the end of the fifth or beginning of the sixth day, is so much accelerated in its progress, about the time the general affection of the system usually takes place, as to have an areola formed within a few hours, or very shortly after the first, and that this areola increases with the first, and again fades at nearly the same time, we must be struck with the similarity, and be forcibly led to draw the conclusions in this case as in the former, respecting the small-pox, viz: that although the inoculated affections had appeared very slight, and no fever had been observed, yet that a certain action had been excited in the constitution. That this was the true constitutional affection of cow-pox, may be judged by the accelerations of the second vesicle to a state of maturity five days before this could have happened, had there been no consentaneous general action or change in the system.

"The truth of this opinion was also soon put to the test of experience, and I now have much satisfaction in declaring that the result appears to answer my most sanguine expectations. In short, my observations on this point lead me to conclude that in order to obtain the proposed criterion in the greatest perfection, the second inoculation should be performed between thirty-six and forty-eight hours before the areola of the first inoculation begins to appear. This is necessary in order that the secondary affection may have proceeded some length, and that a small vesicle containing virus may have been formed by it before the constitutional action from the first inoculation begins; otherwise no areola, but merely a slight degree of hardness, will take place from the second puncture.

"As, on the one hand, the acceleration of the second inoculation in the manner above mentioned, is to be regarded as a

certain mark of a constitutional affection in cow-pox; so, on the other, if it shall be found that no such acceleration takes place, but that the second inoculation proceeds by a slow process through all the stages, and has the duration of a primary affection, it is to be concluded that no constitutional action has taken place from the first insertion of the virus; and when this is the case the second inoculation must be regarded as a primary affection, and a third puncture be made according to the plan laid down for conducting the second inoculation; and thus we may go on until the proper test be obtained, or until we are satisfied that the constitution completely resists the action of cow-pox."

THIRD.—WHAT CAUSES HAVE PREJUDICED THE PUBLIC AGAINST THE OPERATION OF VACCINATION?

There exists a popular belief that by the operation of vaccination diseases are implanted in the system which remain through life; and although a fatal termination is not dreaded, yet the possibilty of impure contamination, and the likelihood that such impurity may be conveyed to the offspring, prevents the ready acquiescence in the performance of the operation, as this fear overcomes any that may exist in relation to even the dreadful scourge of small-pox.

That such belief should be held by any of the medical profession seems totally unaccountable, for it is well known that by proper care, one who performs the operation may be positively certain that no impurity can be thereby conveyed. There are some also who unfortunately practice medicine in the community, although not usually belonging to the regular profession, who either through ignorance, or a desire to impress the public with the idea of the particular advantages to be derived from the extraordinary care they exert in the selection of the virus, with which to perform the operation, who are very willing to represent that any simple eczematous eruption which may occur, subsequent to vaccination is the result of the employment of impure virus. By reason of such an eruption following the use of *animal* virus, the writer, has within a few months past, been threatened with a suit for damages on account of representations to the family, by an irregular practitioner, that the disease was occasioned by the impure virus used. The eruption was a trivial affair, and attended with no symptoms that required any but the simplest form of treatment. It was, however, sufficient, with the aid

of the "medical adviser" to prejudice some persons, who otherwise would have consented to the operation. Thus it comes, that in many cases if the vaccination is accompanied with an undue amount of inflammatory action, or an erysipelatous inflammation supervenes upon the operation, the practitioner is blamed and the virus condemned as impure. Such is also the case when an eczematous eruption appears upon any portion of the body at the time of vaccination or even months afterwards. It is almost impossible to remove doubts from the minds of many people, even those of education, when such sequellæ are observed, and frequently the confidence which has existed between themselves and the physician, is thereby seriously impaired.

It is the purpose in this division of the subject to present facts as they have thus far been demonstrated, in regard to the danger which actually exists of conveying diseases of various forms through the medium of vaccination.

Dr. Fox states that there is a form of Impetigo which has been noticed as frequently following vaccination; this disease of the skin is known as *impetigo contagiosa*, and although it may sometimes have an origin other than in the vaccine virus, yet it is believed that it has also been implanted in the operation. Dr. Henry G. Piffard in the New York Medical Journal, July 1872, gives several cases which go to prove that vaccination does act in some cases as a causative agency, and that this disease may thus originate. "A child was vaccinated about two years ago by a friend and former pupil. During the second or third week thereafter a vesico-pustular eruption appeared upon it, and shortly after upon another child in the family. The parents, much alarmed, discharged the physician who had vaccinated the child, and carried the children to another practitioner, who sent them to me. The diagnosis of impetigo contagiosa was not made at the time; in fact, we expressed ourselves as unable to speak definitely concerning the nature of the affection. The cases were not eczema or ordinary impetigo, and we are now satisfied that they were examples of the affection under consideration.

"A few months subsequently I vaccinated a young lady upon the calf of the right leg, with a crust taken from a perfectly healthy infant. During the third week after the vaccination she returned, and exhibited several vesicles and scabs of impetigo contagiosa upon the same leg and thigh. This case was cured in a few days, to the great delight of the young lady, and of her mother, who feared that some 'unclean' disease had been inoculated with the vaccine." "A child, eight

months of age, was vaccinated about the 1st of last October. During the latter part of the month an eruption of the same description appeared upon the arms and the upper part of the body. This case was presented to the New York Dermatological Society at its December meeting.

"Through the kindness of Dr. Henry F. Walker, physician to the Nursery and Child's Hospital, I was enabled to see, on the 30th of May just passed, four children in one of the wards of that institution, upon whom there had recently appeared an eruption presenting the features of impetigo contagiosa. The cases occurred in the following order: J. H., about four months of age, had been vaccinated by the house physician some four or five weeks previous to the date of my visit. Two or three weeks later the eruption appeared, followed by a similar eruption, upon H. S., aged four months, which was first noticed May 23d, followed by a similar eruption May 26th, upon J. D., aged thirteen months; and May 28th, upon C. G., aged one year."

In regard to the appearances of this form of disease Dr. Piffard says: "Impetigo contagiosa, according to Fox, frequently commences by the appearance of constitutional symptoms of a pyrexial character, varying in severity in different cases. In two or three days one or more small vesicles appear, followed from time to time by others. The vesicles gradually enlarge in size, and two or three days later dry into thin, light yellowish or straw-colored scabs or crusts. The vesicles and crusts may be indefinite in number, and successive eruptions may prolong the disease for months. During the progress of the affection, associates, adults as well as children, may become the subjects of a similar eruption. Inoculation with the fluid contained in the vesicles will produce similar lesions, both upon those who are affected with the disease, and upon others, as has been experimentally determined by Fox and Taylor."

From experiments made with vaccine crusts Dr. Piffard supposes that this impetigo originates in a peculiar form of vegetation observed in the dissolved matter, which is not found elsewhere, and proposes to give these fungoid bodies a distinctive name, *Leptothrix vaccinalis*, depending upon their appearance and habitat. He thus presents the results of his experimentation: "The remarkable fact that impetigo contagiosa does undoubtedly, in a very large number of instances, develop itself as a sequela of vaccination, as exhibited in the recorded experience of Fox and others, as well as of myself, has led me for some time to suspect that there existed some

closer connection between the two than mere coincidence. The coincidences were too frequent to be explained by the doctrine of chance. In fact, at the meeting of the Dermatological Society referred to, such connection was suggested by me, a view, however, which did not meet with favor. My subsequent experience tended to strengthen the conviction of the possibility of vaccinia standing in a causative relation to impetigo contagiosa, and induced me to make a careful microscopical examination of vaccine matter—for a plentiful supply of which I am under obligation to the vaccine establishment of the New York Dispensary, under the charge of Dr. F. P. Foster; to Dr. Darkin, of the Demilt Dispensary, and to their friends. Fresh lymph, in tubes, from Dr. Foster, was carefully examined with amplifying powers of from 500 to 1,500 diameters. Nothing of an organized nature appeared upon examination, with the exception of minute bodies, by Beale termed 'bioplasts,' and by Chauveau 'vaccinads.' These bodies are supposed by both, and in fact pretty certainly determined by the latter gentleman, to be the active agent of vaccinia, and consequently a necessary and normal constituent of pure lymph. The result, as might have been anticipated, being negative, attention was directed to the examination of vaccine crusts.

"Portions of vaccine crusts were placed in small phials and clean test-tubes, and a little more than covered with solutions of caustic soda, potassa, or ammonia, of varying strengths. After the lapse of from one to twenty-four hours, depending upon the strength of the caustic solution employed, more or less complete liquefaction of the crusts was found to have taken place. A drop of this fluid was removed from the phial, by pouring it upon the slide, and examined microscopically, with the same amplifying powers employed in examination of lymph. Upward of twenty vaccine crusts were examined, and in *every instance fungoid bodies, similar to those observed in impetigo contagiosa, were found*, with the sole difference that in vaccine crusts the fungus was more abundant and more luxuriant than in the majority of crusts derived from the other affection."

It will be observed that in pure *lymph* no traces of these peculiar fungoid formations could be observed, and that it was in the crusts of vaccine virus and of the impetigo that they were discovered. Might it not be concluded that their origin was in some fermentative change taking place in the organic constituents of the crusts themselves, and that the same result might be noticed in scales removed from the various forms of

eczema, as well as this one of impetigo. The fact that no such forms were observed in the clear lymph would certainly show that they were entirely foreign to the virus in its perfectly pure condition. It would certainly be valuable in this connection to know whether any cases of impetigo resulted from the use of lymph, or whether the dissolved crust was invariably employed, when this disease occurred as a sequella. It has been the experience of the writer to observe many cases of eruption following vaccination, and some might be classified as belonging to the form of impetigo mentioned by Dr. Piffard, but certainly in most cases they in no wise differ from the common forms of eczema. That such cases of eruption do occur, following vaccination, there is no doubt, but it is certainly difficult to trace their origin to the vaccine virus employed. It is far easier to suppose that the disease results from a predisposition upon the part of the children to a development of eruptive skin affections following a disease of an acute inflammatory nature. This is known to be eminently the case with measles and scarlet fever. Is it not therefore probable, that in a certain number of cases, where the inflammatory action has been high, and the general system has been brought fully under the influence of the vaccine disease, that such results may be observed.

There are many authorities who emphatically deny the possibility of conveying any form of disease through the medium of the vaccine lymph. At the Childrens' Hospital, Paris, M. Taupin vaccinated a large number of children with virus taken from subjects affected with itch, scarlatina, measels, varicella, varioloid and variola, rachitis, scrofula, tubercles, chronic eruptions of the scalp, dartres, etc., without communicating to the patient any of these affections, either those of an acknowledged contagious or non-contagious nature.—[*Meigs and Pepper, page* 168.

Dr. Gregory mentions the case of a child who had been exposed to the infection of small-pox and was afterwards vaccinated. Both diseases were developed. A lancet charged with lymph from the vaccine vesicle produced cow-pox; another lancet from a *variolous* pustule, *formed within* the vaccine areola communicated small-pox.—(*Lecture on Eruptive Fevers page* 270.) This same fact is observed in many other cases, and shows that it is impossible to obtain more than one form of virus from a true cow-pox vesicle. A late writer mentions that "to show that two poisons can not be present in a true Jennerian vesicle, lymph may be taken from a vesicle developed in a person who has been vaccinated too late to prevent

the development of small-pox, and used without the slightest hesitancy for vaccinating another child.—[*Edinburgh Medical Journal*, November, 1871.

Some years ago, John Simpson, F. R. S., Medical Officer of the London Board of Health, requested an answer to the following questions, from some of the eminent medical men of Europe: "Have you any reason to believe or suppose (*a*) that lymph from a true Jennerian vesicle has ever been a vehicle of syphilitic, scrofulous, or other constitutional infection to vaccinated persons; (*b*) or that unintentionally inoculation with some other disease instead of the proposed vaccination, has occurred in the hands of a duly educated medical practitioner?"

Prof. Hebra, of Vienna, among many others, answered the question in the following manner:

"This widely grasping question requires several separate answers, because queries are made:

1. "*Whether the lymph of a vaccine vesicle may, besides its peculiar virus, contain another infectious principle, e. g., that of syphilis?*

2. "*Whether constitutional non-infecting diseases, as, for instance, scrofula, may be transmitted by the inoculation of cow-pox matter?*

3. "*Whether a vaccine vesicle possesses such characters that it may easily be distinguished from other similar vesicles, blebs, or pustules?*

His answers to these three queries may be briefly stated as follows:

(1). "The transmissible infectious principles which have hitherto been recognized, by means of inoculation, are the syphilitic virus, contained in the pus of a chancre, and the virus contained in the cowpox vesicle, and the small-pox pustule. The question, therefore, is simply whether these morbid poisons have ever been mixed? Whether inoculations have ever taken place with such a mixture? And what results have been obtained from such an operation? The answers to these questions are. Inoculation with secretions of this kind, viz: Containing, as it were, several special poisons, either produced no effect at all, or only generated a chancre, by inoculating a mixture of pus from chancre and vaccine pus; and only cow-pox, by inoculating a mixture of vaccine lymph and blenorrhagic matter. Hence, one morbid state only was produced, either cow-pox or syphilis; the latter circumstance being a proof that both poisons are not *simultaneously* transmissable.

This opinion is supported by the experience of Heim, Ricord, Bousquet, Taupin, Landoury, Friendenger, and others.

(2). "We know from experiments made for the purpose (Heim), and from accidental inoculation, that regardless of the quality of vaccine lymph, the latter may be inoculated from syphilitic upon sound individuals: and, on the other hand, from sound subjects upon such as are under the influence of systematic syphilis, without propagating syphilis along with the cow-pox.

"What has been proved of syphilis must, *a fortiori* hold good as regards other constitutional morbid states, as direct inoculation with secretions peculiar to these diseases, have always yielded a negative result.

3. "Every morbid appearance on the cutaneous envelope has its own peculiar characters, by which it may be distinguished from other similar phenomena. The vaccine vesicles presents in like manner sufficiently striking peculiarities as to form, size, number, locality, and particularly as regards its course, to enable the observer easily to establish a distinction between the same and other vesicular, bullar, or pustular eruptions."—[*Parliamentary Reports*, 1857.

Although it has not been shown that two forms of inoculable virus have ever existed together in a typical vaccine vesicle, yet it is well-known that syphilis has been transmitted from one person to another, by the operation of vaccination. Fortunately these cases are extremely rare, as compared with the immense number of vaccinations performed. For, as an able writer (Curschmann) says, "could the opponents of vaccination show that this occurs with any degree of frequency, or is with difficulty prevented, vaccination would thereby receive a severe blow."

Many instances might be produced to show that such a danger actually exists, and that the popular fear of impure inoculation has foundation in fact. It is, therefore, very necessary for the welfare of humanity that all should be made acquainted with the exact truth in regard to the danger of such inoculation, and also the ready means at command to obviate the possibility of such infection.

Trousseau fully considers this question in his Clinical Lectures to students, and concludes that syphilis may be transmitted in vaccination. "But, gentlemen," he says, "there is a point to which I desire to call your special attention to-day: It is *never to vaccinate with lymph taken from one under the influence of syphilitic diathesis.* The transmission of the great-pox by vaccination is a fact which now seems to have been demonstrated. Since the begining of this century, and particularly in later years, cases of this kind have been re-

corded both in France and in other foreign countries; to them I can add one which you have seen in the Clinical wards, and which I shall now briefly recall to your recollection:

"The patient, a young woman, eighteen years of age, came into the "Hotel Dieu" for a uterine affection. As we had at the time some cases of small-pox, I recommended that she should have herself vaccinated. The lymph was taken from a child apparently in perfect health, and from the same lymph four infants in the nursery ward were also vaccinated. Cow-pox was regularly developed in the children, and during their residence in the hospital nothing anomalous was noticed, but unfortunately when they left we lost sight of them. The young woman had false cow-pox; on the day after vaccination the punctures became salient; they were surrounded by an inflammed areola, and accompanied with great itching of the skin; in four or five days no trace of puncture remained. The patient then left us, but it was agreed that she should return once a fortnight to follow out the treatment of the uterine affection. On her first return, twenty-three days after vaccination, she drew attention to the punctures on both arms; two of those on the left arm seemed to have taken. I observed that the pustules were ecthyma. At her next visit, a fortnight later, the pustules of ecthyma were observed to have become transformed into scabs of rupia, indurated at the base; in the axilla, we found some of the lymphatic glands in a state of indolent turgescence. Finally, an eruption of roseola clearly showed that the woman was under the influence of syphilitic poisoning, and that the starting point of the poison was incontestably the vaccination pustules."

M. Ricord, who also observed this case, confirmed the diagnosis of Trousseau, and while he does not deny the possibility of propagating syphilis by means of vaccination, still he would be careful to consider the facts connected with every such case. "It is necessary," said he "to distrust the evidence of our senses. It is only by taking into account the obscurity which must necessarily surround a pathogenic interpretation of an usually retrospective character, and carefully guarding against the errors that a supefircial observation may give rise to, that we can hope to discover the solution of so important and intricate a problem. We have now entered upon a period of reaction against hitherto accepted doctrines, and if we do not take care, we will almost be inclined to pronounce a man affected with syphilis if he has ventured without an umbrella in some of the less reputable streets of the Capital."

The case reported by M. Trousseau, as above related, would be much more conclusive, as demonstrating that the syphilitic

disease had been conveyed by the vaccination, if it had been continuously under observation; the possibility of receiving the virus during the fortnight in which the patient was absent from the hospital, detracts somewhat from its value as a conclusive demonstration of vaccine syphilitic inoculation. But, fortunately, other cases have been recorded which are not open to this objection; fortunately, because if such a possilbility exists, the profession and the public should understand the fact, and know how to guard against it. "Gentlemen," says Trousseau, " you know how many questions have been recently raised in relation to cases of this kind. The subject is one of grave importance, and its discussion is not yet closed. If some physicians still doubt the possibility of syphilis being communicated in vaccination, the majority are open to the logic of facts, and remain on the alert. But among those who constitute this majority, what diversity of opinion exists. Some hold that syphilis is transmissable and inoculable through the medium of the vaccine virus, others absolving the vaccine virus from all blame, hold the syphilitic virus passes with the blood which has accidentally been drawn in taking the lymph from the pock. I shall not stop to discuss the two classes of facts by which the views are supported, as my own experience is insufficient to solve the difficulty. The fact which I wish to impress upon you is this, that syphilis has in numerous cases been transmitted in vaccination."—[*Trousseau's Clinical Lectures*, vol. 2, page 124.

During the Spring of 1861, an unquestionable outbreak of vaccinal syphilis occurred in the valley of Rivalta, Piedmont. The Italian government appointed Dr. Pacchiotti, of Turin, to report upon the attack. The following account, as published by him, is taken from Erichsens Surgery. " In May, 1861, an apparently healthy child, named Chiabrera, was vaccinated at Rivalta, with lymph sent from Aqui for the purpose. Ten days after this vaccination, on June 7th, forty-six healthy children were vaccinated at one sitting from this child. Again, on the 12th of June, seventeen other healthy children were vaccinated from one of the forty-six. Thirty-nine of the first series of forty-six, and seven of the second series of seventeen, received syphilis with the vaccine disease. Making a total of forty-six out of sixty-three children in a mountain village, simultaneously inoculated with syphilis. Some months elapsed before the vaccination was suspected to have been the source of the children's bad health. By the 7th of October, when attention was drawn to this spreading disease, six of the forty-six of the syphilized children had died, without receiving any

treatment; fourteen were recovering, and three were in a precarious condition. Twenty-three were dispersed throughout the country, and their condition was unknown until further researches traced them out. In addition to the children, twenty women suckling them were inoculated with syphilis from the children. Through the mothers, the disease had reached some of the husbands, and even the elder children of the different families."

It was shown that the infant from whom the virus had been taken for the first series of vaccinations, was inoculated with syphilis by a wet nurse who was caring for it, and who was proven to have been affected with that disease.

The committee, however, who were appointed to examine into the matter, did not express a decided opinion that the syphilis was dependent upon the vaccination, but considered that further investigation was necessary. It seems difficult at the present time to understand why there should have been any uncertainty in the minds of these examiners, but when it is remembered that this was the first instance when such an extensive spread of the disease had been noticed, and that the attention of the profession had scarcely been given to isolated cases of vaccinal syphilis, it can not be considered that a jury of medical men would be otherwise than conservative in endorsing any opinion, which, being made public, would tend to throw disfavor upon such eminently useful a procedure as vaccination. M. Jacoud, in a paper published in the "Gazette Hebdomadaire," says, "these gentlemen were both prudent and wise. Before admitting that syphilis in this instance was transmitted with the vaccine matter, many difficulties and obscurities have to be cleared away; it would further be necessary to solve several important questions which at present it appears impossible to reply to. For our own part, an attentive perusal of the documents of the case has led us to the same conclusion as Dr. Albestetti, who exonerates from all blame the vaccinations in question. The events of Rivalta present to our view two conspicuous but wholly distinct facts, viz: the vaccination of the infants and the subsequent apdearances of syphilis in certain of their number. It is granted that these two orders of facts occurred in succession, but for the present we are not prepared to go any further and to argue, *post hoc, ergo propter hoc;* the coincidence is obvious, not so the inference of causalty. Whatever interpretation be adopted as to these facts, they convey a useful caution, and illustrate in an eloquent manner the necessity of taking into account the manifold elements in the etiological history of

vaccinal syphilis and the extreme reserve required of the physician in cases of this description." "This view," said M. Ricord, "is in such perfect harmony with mine that I have nothing to add to M. Jacoud's remarks. Let us admit and carefully inquire into these cases, and let us guard against any predetermined notions on the subject; but as to the interpretation offered, let it be received with an amount of hesitation and doubt, increased by the obvious fact that if ever the transmission of syphilis with vaccine lymph is clearly demonstrated, vaccination must be altogether discontinued, for, in the present state of science, we are in possession of no criterion which may permit the conscientious practitioner to assert that the lymph he inoculates is perfectly free from admixture with blood tainted by syphilis."—[*A. N. Bell. M. D., New York State Medical Society Reports*, 1864.

The occurrence of the Rivalta outbreak of syphilis created quite an excitement, however, in the medical world, and medical societies discussed the question fully, and endeavored to understand the truth in regard to the possibility of transmission of the disease, from one patient to an other, by the means of vaccination. During a discussion in the Paris Academy of Medicine, in the years 1864 and 1865, M. Depaul and Bovier demonstrated the relative frequency of such transmission, and showed that vaccination performed with lymph derived from a syphilitic child may sometimes prove the means of inoculating very many individuals. "Thus," says Trousseau, "in 1856, at Lupara, in the Neapolitan territory, Dr. Maroni vaccinated in the beginning of November a certain number of children with lymph in tubes which came from Campo Basso; it was slightly colored with blood, though as clear and transparent as usual. The first child vaccinated with this lymph was Philomena Listori, aged eight months, and from her the others were vaccinated, of whom besides Philomena Listori, twenty-two, being nearly the entire number vaccinated, took syphilis. These children were born of healthy parents, and all had from their births to the date of vaccination, been free from venereal symptoms. In most the vaccination took effect on the first trial; but in some the operation had to be repeated. The vaccinal pock was followed by characteristic venereal ulcerations, accompanied by swelling of the axillary glands. Then, a little sooner in some and a little later in others, but in the majority about the middle of January, 1857, there appeared eruptions of roseola, impetigo, syphilitic papules, and even pemphigus; these eruptions were soon succeeded by mucinous scabs on the lips, the interior of the mouth, on the parts around the anus,

on the vulva, and on the scrotum, with consecutive enlargement of the posterior, cervical, and inguinal glands, loss of flesh, and a disturbance of the general health proportionate to the severity of the case. The mothers, most of whom suckled their infants, contracted syphilis from them. A series of venereal symptoms at first local, and which Dr. Maroni has well described, manifested themselves in these unfortunates. Some of them communicated the disease to their husbands. From fathers and mothers to other members of the family, to children under puberty of both sexes, and sometimes to entire families. Almost all the women who became pregnant miscarried, bringing forth syphilitic infants, or dead fœtuses presenting in some cases traces of spyhilis. Most of the patients were cured by specific treatment; there was, however, great tendency to relapses; and in some cases two years and a half had elapsed before the disease was eradiated. Some of the infants died, and several of the adults were in jeopardy. Dr. Maroni had taken lymph from the first series he vaccinated for the purpose of vaccinating others. Eleven of this second series contracted syphilis like the first, and communicated it to their mothers, who gave it to eleven nurslings who had not been vaccinated. Some of the women gave the disease to their husbands, and all the young girls were also affected through their contact with the nurses and children. It appears, therefore, that at Lupara thirty-four children were inoculated with syphilis in being vaccinated; and that a greater number of individuals of different ages were directly or indirectly contaminated by these children. At Rivalta there were eighty victims.

"The details now laid before you are given by M. Bouvier. I have now to add, on the authority of M. Depaul, the history of forty infants contaminated with syphilis out of forty-six vaccinated in 1821. According to the report of M. Cerioli, there were thus from four original cases 155 children directly infected with syphilis by vaccination, and there were others secondarily infected through them, bringing up to 300 the total number of syphilitic contaminations. I can not, therefore, too earnestly recommend you to examine with the greatest possible minuteness the subject from which you take the lymph for your vaccinations." (*Trousseau's Clinical Lectures*).

While it is apparent from the number of reported cases of syphilitic inoculation, that beyond any doubt there is a possibility of its conveyance by vaccination, still all the cases which occur subsequent to the performance of that operation, while they appear to be dependent upon the introduction of

the syphilitic poison at the time, are in reality cases in which syphilis pre-existing in the system has been developed by the vaccination. Dr. Tilbury Fox, whilst he does not deny that syphilis may be conveyed in the vaccination, "At the same time," he says, "I am quite sure that very many cases to which this designation is applied are in reality only instances of latent hereditary syphilis excited by the vaccination, and in which the vaccination cannot in any way be fairly blamed for the occurrence of the syphilis. The cases which simulate true vaccinal syphilis are, however, often very successful counterfeits; and a difficulty in disproving that the vaccination itself conveys the syphilitic poison to the attacked arises often-times from the inability to get at any history of syphilis in the parent or parents. The latter naturally try to shift upon vaccination the blame which they should bear themselves."

An essay upon vaccinal syphilis was read in the Amphitheater of the Sorbonne, Paris, in July, 1869, by Dr. G. Lanoix, Chief of the Service des Vaccinations of the Hospitals of Paris, which is as valuable, perhaps, as any other contribution that has been made to the literature of the subject. The essay was published in "*La Tribune Medicale*," a portion of which has been translated and published in this country. The writer demonstrates conclusively that syphilis may be communicated through the medium of vaccination, and believes that there are two forms of vaccinal syphilis.

"In my opinion, gentlemen," he says, "there are two species of vaccinal syphilis, and I am, I believe, the first to establish this division in a precise manner.

"These two varieties are, viz.;

1st. "Evoked vaccinal syphilis.

2nd. "Inoculated vaccinal syphilis.

"Each has its distinct characteristics and distinct source, which enables us to establish its different diagnosis.

"In the evoked vaccinal syphilis one single case may be produced in a large number of vaccinations effected on the same day. The first thing that takes place *is the transformation in situ of the vaccinal pustule into a pseudo-chancre on from the twelfth to the fifteenth day:* immediately thereafter, and in rapid succession, all the other symptoms of syphilis develop themselves.

"When inquiries are made as to the source of vaccine, the child furnishing it is said to be healthy. But if the investigation is followed up as to the health of the parents, it is found that one or the other has been syphilitic, and sometimes also that the vaccinated child has had syphilitic symptoms at the

time of its birth, but which have since disappeared. In inoculated vaccinal syphilis, on the contrary, when several persons are vaccinated on the same day, all or almost all are affected at the same time, with all or almost all the vaccine follows its regular course; it may even reach so far as cicatrization, but then one or more of these cicatrices will break out in from the twenty-fifth to the thirtieth day into a pimple or papula, the starting point of an indurated chancre. This specific ulceration heals slowly, and is accompanied by an indolent ganglionic engorgment, and tardily, say in one and a half months later, the secondary symptoms of syphilis appear. Should the source of this unfortunate development be followed up, it is found that, as in the above cases mentioned, the child who supplied the vaccine was evidently syphilitic, while those who were vaccinated were perfectly healthy before the operation, and belonged to healthy parents."

The same writer says in relation to the occurrence of vaccinal syphilis, that there are numerous and well known cases reported by various authorities, but he does not take the time or space to present any but those which he witnessed himself at the Academy of Medicine, Paris. The following very interesting case is reported by him.

"On the 12th of November, 1868, having called at the St Louis Hospital, Paris, I learned casually from M. Hardy that on the preceding day he had observed a case of vaccinal syphilis in an adult who had been vaccinated at the Academy several months previously.

"Thinking that this might be a new case of epidemic vaccinal syphilis I resolved to make personal inquiries, and I was at last enabled to ascertain the precise day on which this person had been vaccinated at the Academy; it was on the 19th of August preceding; on that same day ten children and thirty three soldiers had been vaccinated.

"Continuing my researches, I ascertained the names of the two children from whom the virus had been obtained; their names were Conrad and Rousselot. A few soldiers only had been vaccinated from Rousselot; Conrad, on the contrary, had furnished most of the vaccine used on that day. On the day I made my inquiries, the 13th of November, nearly three months subsequent to the vaccinations, the child Rousselot was in perfect health. As to the other child, it was dead; its death had occurred two days after having supplied his virus at the Academy.

"In a few words here is the narrative of its life;

"Born of healthy parents and in good health, it was sent

from Paris to a village in the Department of the Basses Pyrenees, and confided to a wet nurse. This woman's loose conduct was well known in the place: under her care the child soon wasted away; its body was covered with ulcers: and after a few months it became so diseased that the Mayor of the place wrote to the child's parents, stating that it had caught the disease from its nurse, and that the child, being in danger of its life, had better be taken away at once. The mother immediately started, and found her child even worse than she expected: it was so emaciated and weak that she expected it to die in her arms: the genital parts and vicinity of the anus were covered with ulcerations and maculae. She returned to Paris with her child, and in a few weeks, under good care, the child appeared much better, and she took it to the Academy for vaccination. This was on the 12th of August; on the 19th she took it back: the vaccinal pustules were found to be regularly developed: from the pustules was taken the vaccine for that days authorized vaccinations; on the 21st the child died of colliquative diarrhœa.

"The unforunate mother felt so convinced that the child had received the contagious malady from its nurse, that the first thing she asked me when I called upon her to question her was whether her poor child had given the disease to any one.

"Having thus ascertained where the vaccine had come from, I made it my first duty, to seek out those who had been vaccinated. I will not detain you with all the details of this long and painful search for several days though Paris and its suburbs: it will suffice, I think, to say that I succeeded in finding all the subjects of that day's vaccination. I reported to Dr. Depaul my sad discoveries, and he accompanied me to see what I had seen. Of the ten (10) children vaccinated on the 19th of August, two (2) had already died before the 14th of November; the others were all syphilitic. You may believe, gentlemen, that I did not rely upon my own judgment uncorroborated: I submitted my diagnosis to such masters as Messrs Bouchut and Ricord, who entirely comfirmed it."

Following this account, he relates the history of three of these cases, which though interesting, cannot be produced here for want of space: it is sufficient to know, however, that they were well developed cases of syphilis. In drawing his account to a close, Dr. Lanoix says. "Such are some of the facts: the others were all similar. If any one doubts, gentlemen, I wish he had been with me on that sad pilgrimage through the homes where vaccinal syphilis had left its blighting trail; he would have been convinced."

It is evident from the foregoing cases that the dreaded disease syphilis, has been implanted into a perfectly healthy individual through the medium of the operation of vaccination, and it is, therefore, of great importance that when such cases do occur, they should be brought prominently into notice, for the reason that each additional case more fully demonstrates the possibility of such infection, and enables the profession to take such measures as to obviate the danger, and at the same time remove the prejudice which exists among the people.

"As regards *Prevention*, Mr. Hutchinson thinks it of the first importance to diffuse the knowledge, that vaccination syphilis is possible, widely amongst the profession. Until all medical men believe in it, and fear it, we shall still be unsafe."—[*Half-Yearly Abstract, July*, 1873.

It is vain for the medical profession to contradict the assertion that syphilis has been conveyed by vaccination. The people believe that in every case of vaccination there is great risk, and it is almost impossible to so remove this prejudice as to gain a willing consent to the performance of the operation; in fact, this has been the greatest barrier in the way of popularizing vaccination.

Although it has not been conclusively demonstrated that in the lymph taken from a typical vesicle, there exists other than pure vaccine virus, yet too much care can not be exercised in selecting the subject from which the supply is obtained. It is difficult to understand how any one can be so careless, or worse, reckless, as to employ virus from a subject in which there exists even a suspicion of syphilitic disease. If the appearance of the child at the time the lymph is taken does not present symptoms of the disorder, the physician is none the less culpable if he does not investigate the history of the child, previous to the time of taking the lymph, in all cases going back to ancestry, for transmission of syphilis by inheritance, is fully established. In all cases of reported vaccinal syphilis, an examination of the source from whence was obtained the supply of virus, has invariably shown, that there were sufficient signs of existing syphilis, to have deterred from its employment. This is very markedly shown in the case of the child "Conrad," reported by Dr. Lanoix, as even the mother was so fearful that the child had been the medium of inoculation, that she questioned the physician on the subject before he mentioned the fact to her. In no case should matter be taken from one laboring under the syphilitic diathesis. It is, therefore, impossible to agree with Dr. Viennoues, of Lyons, in admitting that such a procedure is ever allowable. He

says: "If special circumstances make it necessary to take vaccination lymph from a syphilitic patient, great care must be observed to draw the pure lymph, without the slightest admixture of blood or syphilitic humor." Is it possible ever to be certain that this rule has been complied with? *Emphatically, No!* Therefore discard entirely the matter so taken, even if it is impossible to obtain other virus for the performance of the desired vaccination.

The theory has been advanced that the syphilitic poison is conveyed through the medium of the blood with which the vaccine lymph might be contaminated, and while it is impossible to obtain any but pure lymph from the typical vesicle, still there is a possibility of inoculating the disease by reason of this admixture of blood. Other eminent investigators believe that the poison may exist in the lymph of a typical vesicle, not intimately connected with the vaccine virus itself, but associated with some cell elements of the blood, which does not necessarily appear the color of blood. Some writers have endeavored to show this to be the reason why all individuals vaccinated from the same virus, do not present the signs of syphilization. Mr. Johnathan Hutchinson, Surgeon to the London Hospital, has reported a series of cases of vaccination syphilis, in which he argues this subject at length; he asks: "What are we to infer from the circumstances that when syphilis is conveyed in the practice of vaccination it does not affect all those vaccinated from the tainted source?" In answering, he says: "We must believe that the specific poison of syphilis is either not contained in the vaccine lymph at all, or is not equally diffused through it. Thus, in the first series of cases, two out of twelve vaccinated escaped syphilis; in the second series, out of about twenty-six vaccinated more than half escaped; while in the third and fourth series only one out of at least twelve vaccinated from each vaccinifer is known to have been syphilized. It will be borne in mind, however, that the last two series have purposely not been followed up exhaustively, and that the proportion tainted with syphilis is not improbably greater than appears at present. Again, from the evidence of these series of cases, there is no doubt that we may vaccinate from a tainted vaccinifer without conveying syphilis; and, on the other hand, it is possible to convey syphilis either with or without the production of a normal vaccine vesicle. Vaccination from a child, evidently syphilitic, is known to have been done inadvertently several times, without bad results, and probably it has often occurred without being known. These points of clinical evidence make it highly probable that

the syphilitic virus is not contained in the vaccine virus, but is derived from, or associated with, some cell elements of the blood, and probably they may not be visibly red. This is confirmed by experimental evidence, for syphilis has been successfully produced by inoculating the blood of a patient in the secondary stage; and in the case referred to, the dates, etc., agree closely with those observed in the author's series. Next, need blood be used in vaccination in order to convey syphilis? The author thinks that probably it is enough if the material used has been mixed with colorless exudation from the blood, as occurs when the vaccine vesicle is allowed to drain in order to furnish more lymph. This is confirmed by the fact that the vaccinators in the case in question, asserted that they scrupulously avoided making the vesicle bleed. In none of the instances is there any history that the lymph was visibly bloody, while it is well known that many men of large experience do allow the vaccine vesicle to weep. According to this supposition, as soon as the first contents of the vesicle are exhausted the risk begins. If the syphilitic virus, and the vaccine virus be implanted at one and the same time, what will be the course of events? If the patient is susceptible of vaccination, the vesicle goes through its usual phases and heals, and nothing more happens till the end of the month, when the scar indurates and the chancre forms. In some cases, however, the vaccination sore never heals, and in these the scab somewhat obscures the character of the chancre."—[*Half-Yearly Abstract, July*, 1873.

This is certainly one of the most difficult questions that can be presented for investigation, as it is impossible to understand why a disease which exists in the blood may not be transferred to an individual who has no such contamination, as readily by any portion of the blood which may exude into or around the vaccine vesicle, as by the blood itself directly transfused. Trousseau acknowledges that: "It is rather difficult to understand how that which is contained in the serum of the blood, should not also be contained in the serosity of the vaccinal pock." When science demonstrates the nature of the syphilitic poison, and designates the characteristic form and appearance of its particular cell-formation, then, and not till then, will such questions be definitely settled.

While ignorance upon these points must be admitted, it is of the utmost importance that vaccination should be universally enforced. To attain the desired end, it is imperative, that popular prejudice should be removed, the danger of syphilitic innoculation has been, and is the chief reason given by those

who oppose the performance of the operation. It is useless to insist that this prejudice is unreasonable, the people themselves do not think so, and certainly remembering the cases which have been presented in these pages, it is useless for the profession to ignore the fact, that some danger exists; and while the great fear of contamination expressed by the majority of the laity is doubtless exagerated, it has nevertheless sufficient foundation in fact, to enforce consideration on the part of the medical profession.

In latter years, animal virus has been furnished in large quantities, by those who have given attention to its propagation, this can always be relied upon as pure, when obtained from a reliable source; the people understand that no syphilitic contamination is possible when this form is employed, and will willingly give consent to the operation, when the employment of animal virus is guaranteed. Although this wish may appear to the profession as unreasonable, it should in all cases obtain, and no doubt much of the opposition to the operation which has been such a formidable barrier in the way of compelling attention to the enforcement of the procedure will thereby be overcome.

FOURTH.—WHAT MEASURES SHOULD BE INSTITUTED TO ENFORCE A DUE APPRECIATION OF THE BENEFITS OF VACCINATION?

It would seem that the facts presented in the three preceding divisions of this paper, would be sufficient to show to all the desirableness of countenancing the operation of vaccination; but, as has been previously stated, the prejudice, is so great, in the minds of many who have given limited attention to the subject, that it would require an indefinite time to impress the necessity of immediate attention to the matter, by arguments or published facts. There is also a large class of people, who know nothing about the operation or the benefits to be derived from its employment, who through ignorance, therefore, are unvaccinnated, thereby becoming the media by which small-pox may be indefinitely kept alive in any community. This class of persons can not be reached but by authority, and the question of the enforcement of compulsory procedures has for years past demanded the attention of legislators.

Unfortunately there is always a difficulty in the way of enforcing such laws as at all interfere with the prejudices of any considerable number of the people. In this country, until

very recently, this prejudice has prevailed to such an extent that scarcely any attention has been given to the enacting of laws compelling a proper attention to the subject. That there are many obstacles in the way of successfully carrying such laws into effect no one doubts, but, on the other hand, the good of the public demands that no prejudice alone should be allowed to render inoperative such enactments as appear necessary for the welfare of all. Dr. Elisha Harris in a paper read before the "Public Health Association" says, "while the plainest laws of social and political economy may fully warrant the enactment of whatever laws are requisite to prevent pestilential diseases, the prevention of small-pox is secured only by a kind of inteference with the individual which must first be justified upon the ground that, in the first place, the safety and welfare of mankind demand it, and secondly, that the laws and all procedings under the laws are so applied as to do the individual no harm."

The question of enforced vaccination has occupied the attention of nearly every civilized nation, and the results of the compulsory observance of the procedure have conclusively shown the wisdom of such regulations.

The beneficial results derived from an intelligent enforcement of the operation of vaccination, has been clearly exemplified, in the history of small-pox in Sweden. In that country as early as the year 1803, a law was enacted whereby the inhabitants were compelled to give attention to the subject, and as the result the deaths from small-pox are now but 2.7 in 1,000 from all causes.

It was the chief object of those having charge of the enforcement of the Swedish law, to endeavor, by discussion and otherwise, to remove the prejudice of the people, and thereby popularize the operation. In this work the clergy were foremost in persuading the laity to give ready assent to the measure, and to their zeal much of the success of the medical profession must be accredited. Dr. Hedin, Physician to the King writing from Stockholm during the winter of 1814, says: "The archbishop bishops, and the whole of the clergy throughout the kingdom, having, from the time of the happy discovery of vaccination, embraced it with the most distinguished zeal; and many of this respectable body having not only employed the most effectual means for the removal of vulgar prejudices against it, but having even actually practised vaccination themselves; the king, assured of the continued exertions of the clergy in the same cause, was pleased to direct, that every minister should superintend the progress of vaccination

within his parish; and should be empowered to call to his assistance one or more inspectors of vaccination, according to circumstances, for the purpose of causing all children to be properly vaccinated within the first year after their birth, and keeping proper documents of the performance of the operation. In each parish or district there must be an accredited vaccinator, whose duty is to perform vaccination, and to give a report of his proceedings to the Royal College of Health."

In order that the public might gain an accurate knowledge of the nature of cow-pox, the same writer says. "The college has also published, by the kings command, a Book of Instructions for vaccinators and inspectors of vaccination, which has been distributed gratis to all the churches in the kingdom. This treatise, adapted to the use of the public, affords an accurate knowledge of the true and false cow-pox; of the varieties which most frequently occur in it, and of the cutaneous diseases, which occur so often in Sweden, very nearly resembling the small-pox.

"*For the more effectual encouragement of the practice of vaccination, the king has been graciously pleased to appoint rewards of two different kinds—pecuniary premiums and honorary medals.* The latter are distributed, commonly in silver, but sometimes in gold, to those who have particularly distinguished themselves. In all cases, those who have deserved rewards, are humbly pointed out to the king, by the College of Health: and his majesty has reserved to himself the right of assigning the proportions in which those rewards shall be distributed. *It is also in the king's name, and with a certain degree of publicity, that these marks of his approbation are bestowed.*"

At the early date of the establishmement of the Swedish vaccination regulations, a great difficulty was experienced in the procuring of a supply of reliable vaccine matter, and in order that this obstacle might be removed, an establishment consisting of a director and inspectors of vaccination was ordered by the Government. "The director is a member of the Royal College of Health, whom the king has graciously commanded to receive and examine reports, to answer all inquiries, to conduct the distributions of vaccine matter, which is delivered, free of postage, to all persons who apply for it; and, lastly, to report to the College everything relating to vaccination that requires further regulation, and propose to it, as proper persons to receive rewards, all those who appear to be the most deserving. He has also the immediate inspection of all the medical men, who are appointed to conduct the business

of the stations, established in almost every province; the progressive vaccination performed at these stations being calculated to maintain a constant supply of fresh matter, which is also distributed, free of postage, to those who require it; and their proceedings being registered in proper catalogues and journals. In Stockholm, three several stations of this kind have been appointed, whence fresh matter may always be procured with certainty, if it happens to be wanting in any particular province." (*Dr. Hedin's Letter*, 1814).

By instituting a comparison between the various laws of the present day, it will be found that all those which are effective are, to a great extent, modifications of this Swedish law; this fact will be especially noticed in the compulsory enactments of the State of Maryland, which are the most comprehensive of all now in force in this country.

In England the first attempt made to legislate upon the question of vaccination, was the Vaccination Act of 1841, one of the provisions of this law made the practice of inoculation unlawful. For twelve years thereafter, there was no attempt made to compel any one to give attention to the operation. In the year 1853, an act, known as Lord Littleton's Vaccination Act became a law, thus making vaccination, to a certain extent compulsory. In regard to this act Prof. Aitken says, in the last edition of his valuable work upon the practice of Medicine; "It is now well known that Lord Littleton's Vaccination Act (1853), has proved but a very imperfect measure, a piece of legislation which has fallen far short of accomplishing all that is yet required. The inefficiency and imperfect working of the act has been fully shown. (1). In the Reports of the Registrar General for 1854; (2). By the medical profession generally; (3). By the medical registrars in particular; (4). By the public, as expressed now and again in the newspapers of the day. The unsatisfactory working of the vaccination act of 1853, now amply proven, has led to the promulgation of an order of the Privy Council (of date December 1, 1859), for the improvement of public vaccination. Their Lordships have seen fit to direct the commencement of a *systematic inspection*, with reference especially to the operation of vaccination, and its efficiency in Unions where the amount of infantile vaccinations, compared with the number of births, appeared to be especially low. These inquiries continue to show that the present law, "to extend and make compulsory the practice of vaccination, is so imperfect as to be almost inoperative; and the *systematic inspections* instituted seem to have been so useful in promoting vaccinations, that their Lordships propose to continue them throughout all the Unions of England."

In February, 1871, Mr. T. S. Fiske moved that a committee be appointed to inquire into the operation of the Vaccination Act, and to report the best means for the more effectual enforcement of it. The results of the inquiry should, he urged, be reported, that the people might see whether the Act was a failure or not. Dr. Brady, the Irish Chief Secretary, had stated that the Act was not enforced in Ireland, where only one person in every [illegible] was vaccinated. Nevertheless, the disease was [illegible] there than in England, where vaccination had been enforced, and where it had almost vanished. Nevertheless, [illegible] that it would be more [illegible] would be followed before such a committee was [illegible] Fiske declared that he [illegible] such persons of the [illegible] — *Annual Register of Events for 1871*, p. [illegible]

It will be observed by an examination of the powers vested in the authorities of vaccination, that attention has been given to the qualifications of those who are expected to perform the operation, so that, at the same time the people are compelled to undergo the vaccination, they are guaranteed that a careful and skilful attention shall be given to its performance, by perfectly competent vaccinators.

Thus, in the Public Health Act of England, passed in 1858, the Privy Council has the power of issuing such regulations to secure a due qualification of those persons who may be contracted with for the vaccination of poor persons, resident in Unions and parishes, and for securing the efficient performance of vaccination. "One of the most important indirect results of this power in their hands, is the appointment of public *vaccinators*, to give instructions in all the practical points bearing on vaccination, and, in fit cases, to give certificates of proficiency. They have, moreover, made arrangements for supplying lymph, guaranteed by the National Vaccine Board, to all medical practitioners who apply."—*Cyclopædia of Practical Medicine*, *Art. Vaccination*.

That this attention to the performance of the operation by those who enforce its observance, has much to do with the removal of existing prejudices, there can be little doubt, and it is but just that such attention should be, at all times, given to the institution of the procedure. Dr. Harris has aptly said: "If the State has the right to interfere in any way to secure the public benefits of vaccination for the prevention of the pest of small-pox, then certainly must the same authority

extend to the prevention of imperfect, deceptive, spurious and injurious kinds of vaccination. There is ample reason why every community should wholly prevent midwives, old women, druggists, clergymen and amateurs, and all other persons than the legally qualified physicians, and such non-medical men as shall be specially instructed and licensed for this duty, to perform vaccination."

Within a few years several states have organized Boards of Health, and, therefore, some attention has been given to the prevention of small-pox epidemics. In such states vaccination has been made, to a certain extent, compulsory. Beneficial results have in every case followed the attempts thus made to arrest the ravages of the frightful disease. Unfortunately Ohio has no such laws upon its statute books, and, therefore in many localities small-pox has raged with uncontrolled energy. In Cincinnati, the death rate has been very high on account of the long continued epidemic which visited that city during the past year; as was mentioned in the first pages of this essay, the prejudice of a portion of the citizens was allowed to obtain, through the inefficiency of compulsory enactments. A contrast may be noticed in those cities where proper attention was given to the epidemic when in its infancy. During the prevalence of a severe epidemic in New York and Brooklyn, as well as other Northern cities, during the year 1875, only eight cases of the disease occured in Washington, because when these cases appeared, the Health Officer had the authority to enforce necessary measures to immediately stamp out the epidemic. Dr. Keene in his report to the Board for 1875, says, "Our success in arresting the spread of the disease hasbeen indeed remarkable, and I attribute it entirely to the activity and thoroughness with which we have, in every instance, taken possession of the case and premises. * * * * Activity, promptness, absolute power are the requisites to the accomplishment ot this end. How long will communities and cities suffer these terrible enemies of human life to stalk abroad, numbering their victims by hundreds each week, while facts and figures such as these are presented to prove how easily, how simply, the first approaches may be guarded and the havoc prevented? A statesman in one of his powerful speeches in Congress, referring to some portending political calamity, startled his hearers by exclaiming, "Mr. Speaker, there is a lion at the door! Shall we shut the door and keep him out, or let him in and see if we can get him out again? How great a roaring lion is small-pox when it rages in a city, and how torn and scarred are they who survive the struggle for his

expulsion; and yet how easily the door is shut if we be wise enough to heed the herald of his approach."

"A weapon of defence," says Curschmann, "against small-pox, so powerful as vaccination, should not be left to the pleasure of the individual, but the State has the right and the duty to look after its most thorough performance. As in other spheres, where, for the attainment of a result, perfect co-operation is requisite, so our experience in regard to vaccination teaches us that instruction and admonition alone are almost powerless in the struggle against negligence, deficient sense of duty, and evil disposition, which oppose this useful measure at every step. Those acquainted with the subject, therefore, have long since been of the opinion that to the attainment of the desired end, *legal compulsion* is absolutely necessary. The authority of the State to effect this is unquestionable in the minds of those free from prejudice, for the effectiveness of the method is beyond all doubt. Indeed, even where vaccination has been very imperfectly employed against the decimating plague; the average length of life has undergone an evident increase. Compulsion is furthermore justifiable on the ground that a certainty of success is impossible as long as a few individuals are not subjected to the operation; since from the extraordinary contagiousness of small-pox, these become conveyors and diffusers of the poison. Even if vaccination were considered in the light of a sacrifice, the State might, *under certain circumstances*, demand this from the few in the interest of the community, and upon this basis establish a large number of State institutions. But even the selfish pretext that vaccination is injurious, becomes, as we have seen, in so far untenable as the great number of the formerly accepted dangers of vaccination have been shown to be wholly imaginary, and *the unquestionable harm, which only rarely occurs, can be certainly avoided by means of caution and experience.*"—[*Ziemssen's Cyclopædia, vol.* II, *p.* 416.

Every one, who carefully investigates the subject, must admit that the State has not only the right to enact such laws as are necessary for the preservation of the public against the ravages of small-pox, but it is the duty of all who legislate upon this question to compel those who may be influenced by an unreasonable prejudice, to yield obedience to measures which may be adopted for the welfare of the public. It is difficult, no doubt, to frame laws which will not seem oppressive, and at the same time be effective. As has been said, any measure undertaken to prevent small-pox by vaccination interferes with the individual, and, to a certain extent, with the

freedom of judgment, which is considered so essential in a republican form of government. If, however, the question is fully discussed, and proper attention given to the performance of the operation by those in authority, much of the spirit of opposition will doubtless be removed. Other sanitary questions have been presented to the people by the medical profession, which though altogether differing in many respects from the one now under discussion, still they have been received as fact by mankind, and measures looking to the prevention of many forms of disease have been cheerfully borne by all. The heavy cost of sewerage and drainage is paid without a murmur of disapproval, because the fact has been made apparent by public discussion of the question, that disease and death are the consequence of non-attention to this important matter. As willing an acquiescence will be given to any enactment undertaken as offering immunity from small-pox, if it is shown that such compulsory measures are necessary and harmless.

By referring to the laws now in force in many of the States looking toward the extinction of small-pox by enforced vaccination, it will be found that there is a strange difference in regard to the supposed needs of a community in this respect. Some States ignore the question entirely, others only recommend certain rules and regulations for adoption by Local Boards of Health, whilst others give the authority for the enforcement of laws, exhaustively in detail.

The following statute is all that is found upon the records of our own State, and while it may be considered better than none at all, it certainly does not deal with the question in that full and explicit manner which the importance of the subject demands.

This Act was passed by the General Assembly of the State of Ohio, and is entitled:

"A Bill to provide for vaccination in the public schools of this State, and to prevent the spread of small-pox therein.

"SECTION 1.—Be it enacted by the General Assembly of the State of Ohio, That the several boards of education in this State shall have authority to make and enforce such rules and regulations to secure the vaccination of, and to prevent the spread of small-pox, among the pupils attending, or eligible to attend, their respective schools, as, in their opinion, the safety and interest of the public may require. It shall be the duty of the board of health, town council, or trustees of township, of every city, town, or township, on application of the board of education of said city, town, or township, to provide without delay, at the public expense, the means of vaccination to such

pupils as shall not be provided therewith by their respective parents or guardians.

SECTION 2.—It shall be the duty of the president of every such board to call a meeting thereof, for the purpose contemplated in this act, on the request of any member thereof.

"SECTION 3.—This act shall take effect on its passage."

By the requirements of this act, boards of education are required to make suitable rules and regulations to prevent the spread of small-pox among the pupils of the State. In the first place, the objection to this act is, that a board of education is not the proper body to legislate upon subjects pertaining to medicine or surgery, and in the second place, the security guaranteed by such measures practically amounts to nothing. In Cincinnati, children bearing marks of successful vaccination were frequently the means of carrying the disease to others, unvaccinated; as free intercourse was allowed, too often between families in which the disease existed and those in which it had not appeared.

Another reason why Ohio's law is ineffective, is that it demands that vaccination should only be authoritatively insisted upon, when a small-pox epidemic has declared itself with sufficient emphasis, as to compel a consideration of the subject, through fear alone.

Michigan, by an act passed during the year 1873, established a State Board of Health, having for its object the enforcement of all laws relating to the public health. By reference to the laws intended to prevent the spread of small-pox, while much is found pertaining to the establishment and government of hospitals, &c., but one short paragraph or section is all that is given in relation to vaccination:

"SECTION 45.—Every township may at any meeting make suitable provision for the inoculation of the inhabitants thereof with the cow-pox, under the direction of the board of health or the health officer of the township, and they shall raise all necessary sums of money to defray the expenses of such inoculation, in the same manner that other township charges are defrayed."

In addition to the above, the State Board of Health has recommended the following rules for adoption by the local boards throughout the State.

"Rule 14. Every child should be vaccinated before two years of age; and this board recommends that all persons be revaccinated as often as once in five years.

"Rule 15. All incorporated manufacturing companies within the jurisdiction of this board, shall cause each new employe

to be vaccinated on entrance, unless proof is furnished of previous successful vaccination.

"Rule 16. No person shall become a member of any public school within the jurisdiction of this board, until vaccinated, or furnishing a certificate from some physician that he or she has been successfully vaccinated."

As these rules are simply recommendatory, without penalty, of course they can be considered in nowise obligatory, and are therefore of little value when the question of enforced vaccination is considered, other than as expressing the views of the Health Board.

In the City of New York, in June, 1874, an act was passed for the purpose of securing effective vaccination, and for the collection of pure vaccine lymph or virus.

The Board of Health of that city is empowered by this act to organize a corps of vaccinators, to appoint necessary officers, keep suitable records, collect and preserve pure vaccine lymph or virus, and by the thorough and systematic vaccination of all unvaccinated persons residing in the city, prevent the spread of small-pox therein.

In Washington City, in accordance with "an act for the prevention of diseases in the District of Columbia," passed June 19, 1872, the following rules and regulations were adopted.

"Parents and guardians shall cause their children and wards to be vaccinated before they attain the age of two years, and revaccinated whenever the Board of Health shall, after five years from the last vaccination, require it.

"The Board of Health, hereby orders and requires the vaccination of all the inhabitants in the District of Columbia, and, whenever in their opinion the public health demands it, the revaccination of all persons who do not furnish satisfactory evidence that they have been successfully vaccinated or revaccinated within five years.

"The Board of Health will furnish the means of vaccination to such persons as are unable to pay for the same. For this purpose the physicians to the poor, or their assistants, will be directed to vaccinate the poor gratuitously; and, whenever the exigency requires it, physicians will be employed to go from house to house for the purpose of vaccinating all people who need vaccination.

"Principals of incorporated manufacturing companies, superintendents of alms houses, reform and industrial schools, lunatic hospitals, and of all other charities where the poor and sick are received; masters of houses of correction, jailors, keepers

of prisons, and directors or officers of all institutions supported or aided by the District of Columbia, shall, at the expense of their respective corporations or institutions, cause all inmates thereof to be vaccinated immediately upon their admission thereto, unless they produce sufficient evidence of previous successful vaccination having taken place within five years.

The most comprehensive of all the vaccine enactments are those of the state of Maryland. By these statutes a State vaccine agency is established for the purpose of supplying fresh and pure virus to the physicians of the State, the agent being a physician in good and regular standing, receiving his appointment from the Governor.

In case the parents of a child are too poor to pay for the required vaccination, any physician performing the operation is paid a suitable amount, on presenting evidence that the services were rendered.

Every physician is required to vaccinate all children in the circle of his practice within one year after birth, and all persons who request vaccination must receive the services. If the physician neglects or refuses to perform the operation, he forfeits for every offense the sum of five dollars. The employment of impure virus upon his part, may be punished by the payment of a fine of not less than one or more than five hundred dollars for each offense.

Every parent or guardian who refuses or neglects to have his or her child vaccinated during the first year of life, if entirely free from disease, forfeits for each offense the sum of five or ten dollars. Teachers of schools are not allowed, under the same penalty, to receive a person into any school without the certificate of a regular practicing physician, stating the person has been successfully vaccinated. All fines collected from these sources are paid into the school fund of the county or city, in which such offense occurred.

As has been stated, those communities which have received protection from the compulsory measures, given in the preceding extracts from the laws governing vaccination, have all exhibited the wisdom of such enactments, by a marked decrease in the extent of small-pox epidemics, and the malignancy of the disease when it does occur. This exemption is shown to bear a fixed relation to the manner in which the laws are framed and executed. And although none of the provisions are to be considered perfect in all respects, those which are the most explicit in detail, as the laws of Maryland, are the ones which prove most effective in their practical workings.

As all these attempts of legislation have been for the most part experimental, there is no doubt that experience will enable

the enactment of still more effective measures. This will be certainly the case when the people have become more thoroughly educated, and the benefit derived from proper enforcement of even such imperfect measures as are now upon the statute books becomes more apparent. There is one particular to which attention should be given, although, in many instances, entirely overlooked, which would add much to the effectiveness of all procedures; this is a system of complete registration not only of the births occuring in a community, but also of the cases vaccinated. It is also as necessary that re-vaccination should be enforced as that primary vaccination should be insisted upon. This measure is certainly the most difficult one involved in the whole question, as many who acknowledge the necessity of the primary operation consider that no farther attention is required to the subject through life.

From a careful review of the various laws now in force, together with the recommendations of many health officials, it is evident that more attention should be given to the subject by those in authority than has heretofore been done. No doubt it is difficult for legislators to enact laws which will be effective, and at the same time appear just and reasonable to the public.

The writer of this article would respectfully ask attention to the following suggestions, as presenting some of the measures which should be adopted for the enforcement of vaccination. And although for a time there might appear considerable opposition to their enforcement, still experience goes to show that in those communities where such attempts have been made, good results have invariably followed, and the wisdom of such procedures, therefore, in time, becomes apparent to every one.

First. Vaccination should be made by law compulsory. It should be the duty of every physician to see that this law is enforced in his individual practice. This requirement can be as readily complied with upon his part as the giving of a certificate of birth or death. In order that a ready acquiescence may be given by the people to the enforcement of this enactment,

(1). An attempt should be made to instruct all as to the nature of the operation; and by showing the manner in which all dangers to life and health may be overcome, prejudice will be removed.

(2). All vaccinators should not only attend to the proper introduction of the virus into the system, but should observe the course of the disease to a sufficient extent to know that

it has been sufficiently developed to insure, for a time at least, the individual from an attack of small-pox.

(3). As much prejudice exists in regard to the danger arising from the employment of impure virus, all care should be taken by the vaccinator in selecting the source from whence his supply is obtained. As there is far less prejudice in regard to animal virus, it should be invariably employed when such a demand is made. It would be well for particular boards of health or dispensaries, to so propagate pure and reliable virus that a supply may always be obtained when desired.

(4). A full and complete registry of births should be insisted upon, as necessary for the enforcement of this law. The return of a vaccination certificate should be required during the first year of life in every case.

Second. Revaccination should also be compulsory. In the absence of epidemic influence a revaccination should be insisted upon at the tenth year and again some time after puberty, at about the age of twenty; when a community is subjected to epidemic influence, all should be compelled to suffer a revaccination. No positive assurance exists that an individual will not receive the poison of small-pox until the fact is made known, by a reintroduction of the vaccine virus into the system, followed by no development of the cow-pox disease.

Third. For the enforcement of all sanitary laws, the various boards of health should have full authority, with sufficient means to carry out any measure that may be adopted. It is imperative that constant attention be given to all enactments pertaining to the subject of vaccination, as it is believed that in this way only can the idea of Jenner ever be realized, who believed that in vaccination there is an antidote capable of extirpating from the earth a disease that has been considered the severest scourge of the human race.

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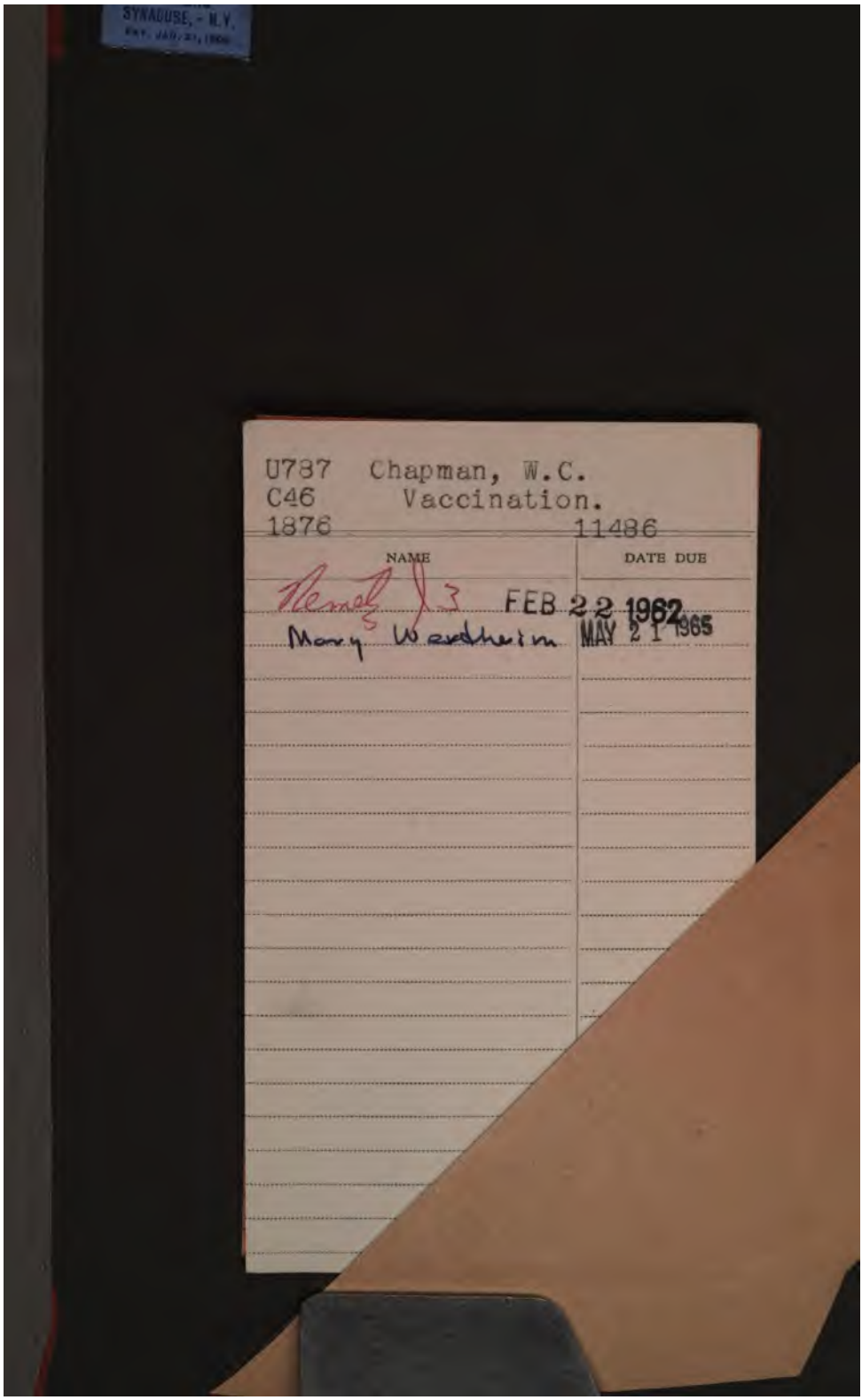
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